The Deſcription and Uſe OF THE CARPENTER's-RULE:

Together with the Uſe of the
LINE of NUMBERS
commonly Call'd

GUNTER's-LINE.

Applyed to the Meaſuring of all
Superficies and *Solids*, as *Board*, *Glaſs*,
Plaiſtering, *Wainſcot*, *Tyling*, *Paving*,
Flooring &c. *Timber*, *Stone*, Square or
Round, *Gauging* of Veſſels, *&c.*

ALSO

Military Orders, Simple and Compound
Intereſt, and Tables of *Reduction*,
with the way of working by *Arithmetick*,
in the moſt of them.

Together with the Uſe
Of the *Glaſiers* and Mr. *White*'s Sliding
Rules. Rendered plain and eaſie for
ordinary Capacities.

By JOHN BROWN.

London, Printed for *R. Mount*, at *Poſtern-Row* on *Tower-hill*, MDCCIV.

BRITISH MUSEUM

TO THE

READER:

Courteous Reader,

THis Little Book was firſt written by me ſeveral years ſince, and hath been accepted of among many, that have had the Peruſal thereof. And ſeveral Impreſſions, in that time, being Sold off, and it being now out of Print, and none to be had, I have reviſed it, and left out what might well be ſpared; and added that which might make it more plain, and eaſier to be remembered.

As for Inſtance, in the uſing of the Line of Numbers (*commonly called* Gunters Line) *for the meaſuring of Board, or Timber, or Stone, the fixed Points or Centers is only* 10 *and* 12, *for ſquare Timber or Stone.*

And in meaſuring of round Timber or Stone (as round Timber) there is uſed only 13. 54 *for Inches, and* 1. 128 *for Foot-meaſure, being the* Diameter *in Inches, and Foot-meaſure of any round ſolid, when* *one Foot in length makes one ſolid Foot of* 12 *Inches every way, or* 1728 *ſolid Cube Inches, which is a foot of Timber, or Stone.*

And if the Circumference, or Girt of the Piece about is given, then the fixed Point or Center uſed, is at 42. 54 *the Inches, and* 100 *part of an Inch about, when one Foot, or* 12 *Inches long makes one Foot ſolid.*

Or elſe at 3. 545 *the Feet, and* 1000 *parts about, when one Foot long makes one ſolid Foot equal to* 1728 *Cube In.*

Alſo, after every Problem, *is the brief way of working it by the Pen, as a proof of the truth of every Operation by the* Rule; *being more than was before in the former Impreſſions.*

Alſo, the Line of Pence *is added to the* Line of Numbers, *and a plain way ſet forth of the uſe thereof by the Line on the Rule. Or the more plain deſcription thereof in a Print of* Gunters Line 11 *times repeated; which may be had with the Book, at* Tower-Hill, *or the* Minories.

The Uſe of the Gunters Line *in the Art of* Gauging, *is here but briefly hinted,* *ed, becauſe there are ſeveral Books of* Gauging, *purpoſely made for that Imployment, more compleat than can be expected in this ſhort Diſcourſe. And Lines of* Area's *of Circles, in Ale-gallons, at any* Diameter *given, from* 1 *Inch to* 200 *Inches; which way is uſed for round or ſquare Veſſels, to give the content of every Inch deep in any taper Veſſel, as faſt as any one can write it down.*

And Directions for the ready meaſuring the Drip, or ſtooping Bottoms of round or ſquare Tuns, and the Liquor about the Crowns of Coppers.

To this Impreſſion is added the Uſe of the Lines called Diameter, Circumference, Square-Equal, *and* Square *within a* Circle, *and to find the* Circles Area, *or* Content *by them; or, having the* Area, *to find the* Diameter, *or the* Circumference *or the* Square-equal, *or* Square-within.

Alſo, to this is added the way by the Pen, to multiply Feet, Inches, and 12 *parts of an Inch together, whereby any Superficies, as Board, Floor, Wall, Yard, or Field may be exactly meaſured by the*

Pen. Alſo, by a ſecond Operation, or Multiplication, may any Solid, as Timber, or Stone, or round Veſſel, be meaſured; the Arithmetical *way whereof is worded as plain as in any Book whatſoever.*

Alſo the Uſe of the Glaſier's Sliding-Rule, *to meaſure* Glaſs, or any *Superficies.*

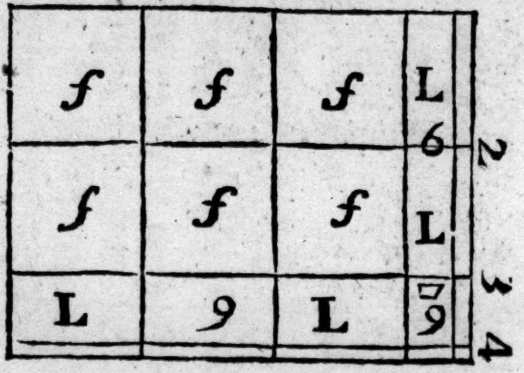
And Mr. White's Sliding-Rule, *to meaſure Timber; being as neat and ready a way as ever was uſed.*

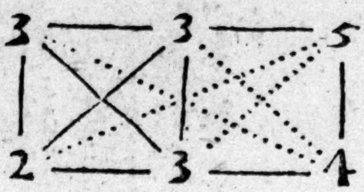
Thus you have a brief Account of what is contained in this little Book, and I wiſh it may be helpful to many a Learner, for whom it is prepared. So I remain ready to ſerve you in this or the like.

John Brown.

From my Houſe at the *Sphere* and *Sun-Dial* in the *Minories, London.*

The





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The Deſcription and Uſe of the Carpenters Rule.

CHAP. I.

IT is call'd a *Carpenters Rule*, (rather than a *Joyners*, *Bricklayers*, *Maſons*, *Glaſiers*, or the like) I ſuppoſe, becauſe they find the moſt abſolute neceſſity of it in their way, for they have as much or more occaſion to uſe it than moſt other Trades, though the ſame Rule may meaſure all kind of Superficies and Solids, which two Meaſurers meaſure every viſible ſubſtance which is to be meaſured. And it is uſually made of Box or Holly, 24 Inches in length, and commonly an Inch and half, or an Inch and quarter in breadth, and of thickneſs at pleaſure; and on the one ſide it is divided into 24 equal Inches, according to the Standard at *Guild Hall*, *London*, and every one of thoſe 24 Inches is divided into eight parts, that is Halfs, Quarters, and Half-quarters; or ten parts, as you pleaſe and the Half-inches are known from the Quarters, and Quarters from the Half-quarters, by ſhort, longer and longeſt ſtrokes, and at every whole inch is ſet figures, proceeding from 1 to 24, from the right hand toward the left, and theſe parts and figures are on both edges of one ſide of the Rule both ways numbred, to the intent that howſoever you hold the rule you have the right end to meaſure from, provided you have the right ſide.

On the other ſide you have the Lines of Timber and Board meaſure, the Timber-meaſure is that which begins at 8 and a half, that is, when the figures of the Timber line ſtand upright to you, then I ſay it begins at the left end at 8 and $\frac{1}{2}$ and proceeds to 36 within an Inch and $\frac{3}{8}$ of an Inch of the end. Alſo at the beginning end of the Line of Timber meaſure is a Table of figures, which contains the quantity of the under-meaſure from one Inch ſquare to 8 Inches ſquare, for the figure 9 comes upon the Rule, as you may ſee, near to 8 in the Table.

On, or next the other edge, and ſame ſide you have the Line of Board-meaſure, and when thoſe figures ſtand upright, you have 6 at the left, or beginning end, and 36 at the other (or right end) juſt 4 Inches off the end unleſs it be divided up to 100, then it is nigh an Inch and half off the end. This Line hath alſo his Table of Under-meaſure at the beginning end, and begins at 1 and goes to 6, and then the diviſions on the Rule do ſupply all the reſt to 100. Thus much for Deſcription: Now for Uſe.

The Inches are to meaſure the length or breadth of any Superficies or Solid given, and the manner of doing it were ſuperfluous to ſpeak of, or once to mention, being not only eaſie, but even natural to every man, for holding the Rule in the left hand, and applying it to the board, or any thing to be meaſured you have your deſire: But now for the uſe of the other ſide, I ſhall ſhew it in two or three examples in each meaſure, that is, Superficial, or Solid. And firſt in Superficial, or Board-meaſure.

Ex. 1. *The breadth of any Superficies (as Board, or Glaſs, or the like) being given to find how much in length makes a Square Foot, (or is equal to 12 inches board and 12 Inches long; for ſo much is a true Foot Superficial.)*

To do this, look for the Number of Inches your Superficies is broad in the Line of Board-meaſure, and keep your finger there, and right againſt it, on the Inches ſide, you have the number of Inches that goes to make up a Foot of Board or Glaſs, or any Superficies. Suppoſe I have a piece 8 Inches broad, How many Inches make a Foot? I look for 8 on the Board-meaſure, and juſt againſt my finger (being ſet to 8) on the Inch ſide, I find 18, and ſo many Inches long, at that breadth, goes to make a Foot Superficial.

Again, ſuppoſe it had been 18 Inches broad, then I find 8 Inches in length, to make a Foot ſuperficial; but if 36 Inches broad, then 4 Inches in length makes a Foot.

Or you may do it more eaſie thus: Take your Rule and hold it in your left hand, and apply it to the breadth of your Board or Glaſs, making the end that is next 36 even with one edge of the board or Glaſs, and the other edge of the Board ſhews how many Inches or Quarters of an Inch go to make a foot of the Board of Glaſs. This is but the converſe of the former, and needs no example, for laying the Rule to it, and looking on the Board-meaſure, you have your deſire.

Or elſe, you may do thus in all narrow pieces under 6 Inches Broad. As ſuppoſe $3\frac{1}{4}$, double $3\frac{1}{4}$ it makes $6\frac{1}{2}$, then I ſay, that twice the length from $6\frac{1}{2}$ to the end of the Rule, ſhall make a Foot Superficial, or ſo much in length makes a foot.

Ex. 2. *Having A Superficies of any length and breadth given, to find the Content, that is, how many Foot there is in it.*

Having found the breadth, and how much makes one Foot, turn that over as many times as you can, for ſo many Foot is there in that Superficies: But if it be a great breadth, then you may turn it over two or three times, and then take that together, and ſo ſay 2, 4, 6, 8, 10, *&c.* or 3, 6, 9, 12, 15, 18, 21, and till you come to the end of the Superficies. Note that the three ſhort ſtrokes between figure and figure, are the Quarters; as thus, 8 and a quarter, 8 and a half, 8 and three quarters, then 9, *&c.* till you come to 30, and then 30 and a half, 31, *&c.* to 36. And if it be divided any further, it is to whole Inches only to 100.

The uſe of the Table at the beginning end of the Board-meaſure.

Firſt, you have five ranks of figures; the firſt, or uppermoſt is the number of Inches that any Superficies is broad, and the other 4 are Feet, and Inches, and parts of an Inch that goes to make up a Foot of Superficial meaſure: As for example, at 5 Inches broad you muſt have 2 Foot, 4 Inches, and 4 Fifths of an Inch more, that is, 4 parts of 5, the Inch being divided into 5 parts; but where you have but two figures beſide the uppermoſt, and Cyphers in the reſt, you muſt read it thus, At two Inches broad you muſt have ſix Foot in length, no Inches, no parts.

Thus much for the uſe of the line of Superficial of Board-meaſure.

The Uſe of the Line of (Solid) or Timber-meaſure.

The uſe of this Line is much like the former: For firſt, you muſt learn how much your piece is ſquare, and then look for the ſame number on the Line of Timber-meaſure, and the ſpace from thence to the end of the Rule is the true length, at that ſquareneſs, to make a Foot of Timber.

Ex. 1. I have a peice that is 9 Inches ſquare, I look for 9 on the Line of Timber-meaſure, and then I ſay, the ſpace from 9 to the end of the Rule, is the true length to make a Foot of Timber, and it is near 21 Inches, 3 eights of an Inch.

Again, ſuppoſe it were 24 Inches ſquare, then I find 3 Inches in length make a Foot, for ſo I find 3 Inches on the other ſide, juſt againſt 24: But if it were ſmall Timber, as under 9 Inches ſquare, then you muſt ſeek the ſquare in the upper rank in the Table, and right under, you have the Feet, Inches,

ches, and parts that go to make a Foot ſquare, as was in the Table of Board-meaſure. As ſuppoſe 7 Inches ſquare, then you muſt ſeek the ſquare Inches in the upper rank in the Table, and right under you have the Feet Inches, and parts that go to make a Foot ſquare, as was in the Table of Board-meaſure. As ſuppoſe 7 Inches ſquare, right under 7, I find in the Table 2 Foot a 11 Inches, and 2 ſevenths of an Inch, divided into 7 parts, and at 8 Inches ſquare you find only 2 Feet, 3 Inches, 0 parts, and ſo for the reſt.

But if a *piece* be not juſt ſquare, but broader at one ſide than the other, then the uſual way is to add them both together, and to take half for the ſquare, but if they differ much, then this way will be very erroneous, and therefore I refer you to the following Rules: But if it be round Timber, then take a ſtring and gird it about, and the fourth part of this is uſually allow'd for the ſide of the ſquare, and then you deal with it as if it were juſt ſquare.

Thus much for the Uſe of the Carpenters Plain-rule.

I have alſo added a Table for the Under-meaſure for Timber and Board, to Inches and Quarters; and the uſe is thus: Look on the left ſide for the number of Inches and Quarters, your Timber is ſquare, or your Board is broad, and right againſt it you have the Feet, Inches, tenth part of an Inch, and tenth of a tenth (or hundredth part of an Inch) that goeth to make a Foot of Timber or Board.

Ex. 3., A piece of Timber 3 Inches 1 quarter. *F. Inch.* 10. 100. ſquare will have 13 7 5 9 parts to make a Foot. And a Board of 3 Inches and a quarter broad muſt *F. Inch.* 10 100. have 3 8 3 0 in length to make a Foot; and ſo of the reſt, as is plain by the Table, and needs no further explication, being common to moſt Artificers.

A Table for the under Timber-meaſure, to Inches and quarters.

in.	*qr.*	*feet*	*in.*	10p	100
	1	2304	0	0	0
	2	576	0	0	0
	3	256	0	0	0
1	1	144	0	0	0
	1	92	1	9	7
	2	64	0	0	0
	3	47	0	2	4
2	2	36	0	0	0
	1	28	4	3	3
	2	23	0	4	1
	3	19	0	3	1
3	3	16	0	0	0
	1	13	7	5	9
	2	11	9	0	6
	3	10	1	8	8
4	4	9	0	0	0
	1	7	11	6	6
	2	7	1	3	3
	3	6	4	5	9
5	5	5	9	1	2
	1	5	2	6	9
	2	4	9	1	2
	3	4	4	2	6
6	6	4	0	0	0
	1	3	8	2	3
	2	3	4	9	0
	3	3	1	9	3
7	7	2	11	2	8
	1	2	8	8	6
	2	2	6	7	2
	3	2	4	7	7
8	8	2	3	0	0
8¼		2	1	3	9

A Table for the under Board-meaſure, to Inches and quarters.

	fe.	*in.*	10.	100
	48	0	0	0
	24	0	0	0
	16	0	0	0
1	12	0	0	0
	9	7	2	0
	8	0	0	0
	6	10	2	9
2	6	0	0	0
	5	4	0	0
	4	9	6	0
	4	4	3	6
3	4	0	0	0
	3	8	3	0
	3	5	1	4
	3	2	4	0
4	3	0	0	0
	2	9	8	8
	2	8	0	0
	2	6	3	1
5	2	4	8	0
	2	3	4	2
	2	2	1	8
	2	1	0	4
6	2	0	0	0
	1	11	0	5
	1	10	1	5
	1	9	3	3
7	1	8	5	8
	1	7	8	6
	1	7	2	0
	1	6	5	8
8	1	6	0	0
8¼	1	5	4	5

Note alſo, that this Table, or any ſmaller part of under-meaſure, may be ſupplyed by the diviſions of the Board and Timber-meaſure only as thus: Double the Inches and parts of breadth for board-meaſure, or of ſquares for Timber-meaſure, and ſeek it in the Lines of Board or Timber-meaſure, and count twice from thence to the Rules end, for Board. or 4 times for Timber, and that ſhall be the true length that makes a Foot of Board or Timber.

Ex. 4. At 4 Inches and ½ ſquare or Broad 4 ½ double, is 9. then look for 9 on the Board-meaſure, and two times from thence to the end, ſhall make a Foot of Board.

Or look for 9 on the Line of Timber-meaſure, and 4 times from thence to the end of the Rule, ſhall be the true length to make a Foot of Timber, at 4 Inches ½ ſquare.

But if it be ſo ſmall a piece, that when it is doubled, the number is not on the divided part of the rule, then double it again, and count 4 times for

Board-meaſure, and 16 times for Timber.

Ex. 5. At 2 inches and a half, a quarter broad, or ſquare, that doubled, is 4$\frac{1}{4}$, which is not on the rule, therefore I double it again, ſaying, 4 $\frac{1}{4}$ and 4 $\frac{1}{4}$ is 8 $\frac{1}{2}$ which, is on the rule; then for Board, count 4 times from 8 $\frac{1}{2}$ on the Board-meaſure, to the upper end by 36, to make a Foot of Board at 2 $\frac{1}{2}$ broad: And for Timber, count 16 times from 8 $\frac{1}{9}$ near the beginning of Timber-meaſure, which will be near 32 Foot, to make a Foot of Timber at 2 $\frac{1}{4}$ ſquare: But if twice doubling will not do, then double again, and count 8 times for Board, and 64 times for Timber, as in the Table you may ſee, which will be very ſlender Timber.

Alſo between the two lines of Inches, is ſet four ſcales of equal parts, called Circumference Diameter, Square-equal, and Square-within.

Whoſe Uſe may be thus.

The Diameter of any circle being given, to find the circumference or the ſide of a Square-equal, or the ſide of the ſquare within.

Example, ſuppoſe the Diameter of a circle be 15 Inches.

Take 15 from the ſcale called Diameter, and meaſure it in the ſcale called circumference, and it gives 47. 10.

Alſo the ſame extent meaſured in the line called ſquare-within, and it gives 10. 55.

For the ſide of a ſquare-within in that circle of 51 Inches Diameter.

Again, the ſame extent being meaſur'd in the ſcale call'd ſquare-equal and it gives 13. 27 for the ſide of a ſquare equal to a circle of 15 Inches Diameter.

Laſtly, this 13. 27 the ſide of the ſquare-equal multiplyed by it ſelf gives 176, the Area of that Circle in Inches, whoſe Diameter is 15 Inches.

The ſame may be done, if the Circumference be firſt given, then that taken firſt from that Line, and meaſured in the other Lines, you ſhall have the reſpective Anſwers, as before.

But if the Area, be firſt given, then to find the Square-equal, find the

Square-root of the Area, and that root ſhall be the ſide of the Square-equal.

Example. Suppoſe the Area of a Circle be 288, what is the ſide of the Square-equal.

The middle between 1 and 288, is at near 17 the ſide of the Square-equal, for 17 ſquared is 289. Then 17 taken from the *Scale* call'd ſquare equal, gives you any of the reſt.

Theſe *Scales* ſerve to draw any Platform of a Houſe or Field very conveniently, being of ſeveral bigneſſes.

The Deſcription and Uſe of the Line of Numbers, (commonly called Gunter'*s Line.*)

CHAP. II.

The definition and deſcription of the Line of Numbers, and Numeration thereon.

THE Line of Numbers is only the Logarithms contrived on a Ruler, and the ſeveral ranks of figures in the Ligarithmes are here expreſs'd by ſhort, and longer, and longeſt diviſion; and they are ſo contrived in proportion one to another, that as the Logarithms by adding together, and ſubſtracting one from another produce the *quæſita*, ſo here by turning a pair of Compaſſes forward or backward, according to due order, from one point to another, doth alſo bring out the *quæſita* in like manner.

For the length of this Line of Numbers, know, that the longer it is the better it is, and for that purpoſe it hath been contrived ſeveral ways, as firſt into a Rule of two Foot long and three Foot long by Mr. *Gunter*, and I ſuppoſe it was therefore called *Gunter*'s *Line*.

Then that Line doubled or laid ſo together, that you might work either right on, or croſs from one to another, by Mr. *Wingate* afterwards projected in a Circle, by Mr. *Oughtred*, and alſo to ſlide one by another by the ſame Author; and laſt of all projected (and that beſt of all hitherto, for largeneſs, and conſequently for exactneſs) into a Serpentine, or winding circular Line, of 5, or 10, or 20 turns, or more or leſs, by Mr. *Brown*, the uſes being in all of them in a manner the ſame, only ſome with Compaſſes, as Mr. *Gunter*'s and Mr. *Wingat*'s; and ſome with flat Compaſſes, or an opening Index, as Mr. *Oughtred*'s and Mr. *Brown*'s, and one without either as the ſliding Rules; but the Rules or Precepts that ſerve for the uſe of one, will indifferently ſerve for any: But the projection that I ſhall chiefly confine my ſelf to, is that of Mr. *Gunter*'s; being the moſt proper for to be inſcribed on a Carpenters Rule, for whoſe ſakes I undertake this collection of the moſt uſeful, convenient, and proper applications to the uſes in Arithmetick and Geometry. Thus much for definition of what manner of Lines of Numbers there be and of what I intend chiefly to handle in this place.

The order of the diviſions on this Line of Numbers, and commoly on moſt other, is thus, it begins with 1, and proceeds with 2, 3, 4, 5, 6, 7, 8, 9; and then 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; whoſe proper power or order of numeration is thus: The firſt 1 doth ſignifie one tenth of any whole number or integer; as one tenth of a Foot, Yard, Ell, Perch, or the like; or the tenth of a penny, ſhilling, pound, or the like, either in weight, or number, or meaſure; and ſo conſequently, 2 is 2 tenths, 3 three tenths; and all the ſmall intermediate diviſions, are 100 parts of an integer, or a tenth, of one of the former tenths; ſo that 1 in the middle, is one whole integer, and 2 onwards two integers, 10 at the end is 10 integers: Thus the line is in its moſt proper acception or natural diviſion.

But if you are to deal with a greater number than 10, then 1 at the beginning muſt ſignifie 1 integer, and in the middle 10 integers, and 10 at the end 100 integers.

But if you would have it to a figure more, then the firſt 1 is ten, the ſecond a hundred, the laſt 10 a thouſand If you proceed further, then the firſt 1 is 100. the middle 1 a 1000, and the 10. at the end is 10000, which is as great a number as you can well diſcover, on this or moſt ordinary Lines of numbers: And ſo far with convenient care, you may reſolve a queſtion very exactly. Now any number being given under 10000, to find the point repreſenting it on the rule, do thus.

Numeration on the Line of numbers.

PROB. I.

Any whole number being given under four figures, to find the point on the Line of numbers that doth repreſent the ſame.

Firſt, Look for the firſt figure of your number, among the long diviſions; with figures at them, and that leads you to the firſt figure of your number: then for the ſecond figure count ſo many tenthes from that long diviſion onwards, as that ſecond figure amounteth to; then for the third figure, count from the laſt tenth, ſo many centeſmes as the third figure contains; and ſo for the fourth figure, count from the laſt induces centeſme, ſo many Millions, as that fourth figure hath unites, or is in value; and that ſhall be the point where the number propounded is on the line of numbers: *Take two or three Examples.*

Firſt, I would find the point upon the line of numbers repreſenting 12, now the firſt figure of this number is one, therefore I take the middle one for the firſt figure; then the next figure being 2, I count two tenths from that 1, and that ſhall be the point repreſenting 12, where uſually there is a braſs pin with a point in it.

Secondly, To find the point repreſenting 144. Firſt, as before I take for 1, the firſt figure of the number 144, the middle Figure 1, then for the ſecond Figure (*viz.* 4.) I count 4, tenths onwards for that: Laſtly, for the other 4, I count 4. centeſmes further, and that is the point for 144.

Thirdly, To find the point repreſenting 1728.

Firſt, As before, for 1000. I take the middle 1, on the line.

Secondly, For 7, I reckon ſeven tenths onward, and that is 700.

Thirdly, For 2, reckon two centeſmes from that 7*th.* tenth for 20.

And laſtly, For 8, you muſt reaſonably eſtimate that following centeſme, to be divided into 10 parts (if it be not expreſs'd, which in lines of ordinary length cannot be done) and 8, of that ſuppoſed 10. is the preciſe point for 1728, the number propounded to be found, and the like of any number whatſoever.

But if you were to find a fraction, or broken number, then you muſt conſider, that properly, or abſolutely, the line doth expreſs none but decimal fractions: thus, $\frac{1}{10}$ or $\frac{1}{100}$ or $\frac{1}{1000}$ and more nearer the rule in common acception cannot expreſs; as one Inch, and one tenth, or one hundreth or one thouſandth part of an Inch, foot, yard, perch, or the like, in weight, number, or time, it being capable to be applyed to any thing in a decimal way: (but if you would uſe other fractions, as quarters, half quarters, ſixteens, twelves, or the like, you may reaſonably read them, or elſe reduce them into decimals, from thoſe fractions, of which more in the following Chapters) for more plainneſs ſake, take two or three obſervations :

1. That you may call the 1. at the beginning, either one thouſand, one hundred, or one tenth, or one abſolutely that is, one Integer, or whole number, or tenintegers, or a hundred, or a thouſand integers, and the like may you call 1, in the middle, or 10 at the end.

2. That whatſoever value or denominations you put on 1 the ſame valve or denomination all the other figures muſt have ſucceſſively, either increaſing forward, or decreaſing backwards, and their intermediate deviſions accordingly, as for example;

If I call 1 the beginning of the line, one tenth of any integer, then 2 following muſt be two tenths, 3 three tenths, *&c.* and 1 in the middle 1 integer, 2 two integers, and 10 at the end muſt be ten integers.

But if one at the beginning be one integer, then 1 in the middle muſt be 10 integers, and 10 at the end 100 integers, and all the intermediate figures

20, 30, 40, 50, 60, 70, 80, 90 integers, and every longeſt diviſion between the figures 21, 22, 23, 24, 25, 26, *&c.* integers, and the ſhorteſt diviſions tenths of thoſe integers, and ſo in proportion infinitely: as [1 ^{10} 1. 10] [1. 10. 100.] [10. 100. 1000] [100. 1000. 10000.] in all which 4 examples, the firſt order of Figures, *viz.* $\frac{1}{10}$ 1. 10. 100. is repreſented by the firſt 1. on the line of numbers, the ſecond order of figures, *&c.* 1. 10. 100. 1000. is repreſented by the middle 1. on the line of numbers: the laſt order or Place of figures, *viz.* 10. 100. 1000. 10000. is repreſented by the 10, at the end of the line of numbers.

3. That I may be plain (yet further) if a number be propounded of 4 figures, having two cyphers in the middle, as 1005, it is expreſſed on the line between that prime to which it doth belong, and the next centeſm or ſmall diviſion next to it; but if you were to take 5005, where there are not ſo many diviſions, you muſt imagin them ſo to be, and reaſonably eſtimate them

accordingly. Thus much for numeration on the line, or naming any point found on the Rule, in its proper value and ſignification.

Note, that ſince this Book was firſt written, I have provided a Print of the Line eleven times repeated, where the Numerator is certainly expreſſed from 0001 to 10000000; and may be had here, or in the *Minories*.

CHAP. II.

PROB. I.

Two Numbers being giving, to find a third Geometrically proportional unto them; and to three, a fourth; and to four, a fifth, &c.

GEometrical proportion is, when divers numbers being compar'd together, differ among themſelves, increaſing or decreaſing, after the rate or reaſon of theſe numbers, 2. 4. 8. 16. 32. for as 2 is half 4, ſo is 8 half 16: and as this is continued, ſo it may be alſo diſcontinued, as 3. 6. 14. 28;

for though 3 is half 6, and 14 half 28, yet 6 is not half 14, nor in proportion to it, as 3 is to 6. There is alſo Arithmetical and Muſical proportion; but of that in other more large diſcourſes, being not material to our preſent purpoſe (though I may hint it afterward.)

To find this by the numbers, extend the Compaſſes upon the line of numbers, from one number to another; this done, if you apply that extent (upwards or downwards, as you would either increaſe or diminiſh) from either of the numbers propounded, the moveable point will ſtay on the third proportional number required. Alſo, the ſame extent applyed the ſame way from the third, will give you a fourth and from the fourth a fifth.

Example. Let theſe two numbers 2 and 4 be propounded to find a third proportional to them (that is, to find a number that ſhall bear the ſame proportion that 2 doth to 4) and then to that third, a fourth, fifth and ſixth, *&c.*) Extend the Compaſſes upon the firſt part of the line of numbers, from 2 to 4; this done, if you apply the ſame extent upwards from 4, the moveable point will fall upon 8, the third proportional required; and then from 8, it will reach to 16, the fourth proportional; and from 16 to 32, the fifth; and from 32 to 64, the ſixth proportional. But if you will continue the progreſſion further, then remove the Compaſſes to 64 in the former part of the line, and the moveable point will ſtay upon 128, the ſeventh proportional and from 128 to 256, the eighth; and from 256 to 512, the ninth, *&c.* Contrarily to this, if you would diminiſh, as from 4 to 2, extend the Compaſſes from 4 to 2, and the moveable point will fall on 1; and from 1 to $\frac{5}{10}$, or 5 of ten which is one half (by the ſecond Problem of the firſt Chapter) and from 5 to 25, or $\frac{1}{4}$, and ſo forward.

But generally in this, and moſt other work, make uſe of the ſmall diviſions in the middle of the line, that you may the better eſtimate the fractions of the numbers you make uſe on; for obſerve, look how much you miſs in ſetting of the Compaſſes to the firſt and ſecond terms, ſo much, or more will you err in the fourth: therefore the middle part will be moſt uſeful: as for example, as 8 to 11, ſo is 12 to 16,50, or 5, if you do imagine one integer to be divided but into 10 parts, as they are on the line on a two foot Rule; but on the other end you cannot ſo well expreſs a ſmall fraction, as there you may.

PROB II.

One number being given, to be multiplyed by another number given, to find the Product.

Extend the Compaſſes from 1 to the Multiplicator, and the ſame extent apply the ſame way from the Multiplicand, will cauſe the moveable point to fall on the product.

Example. Let 6 be given to be multiplyed by 5, here if you extend the Compaſſes from 1 to 5, the ſame extent will reach from 6 to 30; which number 30, though it be numbered but with 3, yet your reaſon may regulate you, to call it 30, and not 3; for look what proportion the firſt number bears to 1, the ſame muſt the other number (or Multiplicand) bear to the Product; which in this place, cannot be 3, but 30,

Another Example, for more plainneſs.

Let 125 be given to be multiplied by 144; extend the Compaſſes from 1 to 125, and the ſame extent laid the ſame way from 144, the moveable point will fall on 18000: now to read this number 18000 (ſo much, and no more) you muſt conſider, that as in 125 there are two figures more than in 1, ſo there muſt be two figures more in the Product 18000, than in the Multiplicand 144: and as for the order of reading the numbers, you may conſider well the firſt Problem of the firſt Chapter.

Some other Examples for more light.

3. As 1 to 25, ſo 30 to 750: as 1 to 8, ſo 16 to 48: as 1 to 9, ſo 9 to 81: as 1 to 12, ſo 20 to 240. One help more I ſhall add, as to the right computati-

on of the laſt figure in 4 figures (for more cannot be well expreſt, on ordinary lines, as that on a two foot Rule is) but for the true number of figures in the Product, note, that for the moſt part, there is as many as there is in the Multiplicator and Multiplicand put together, when the two firſt figures of the leſſer of them, do exceed ſo many of the firſt figures of the Product; but if the two firſt figures of the leaſt of them, do not exceed ſo many of the firſt figures of the Product, then it ſhall have one leſs than the Multiplicator and Multiplicand put together; as, 92 and 68 multiplied, makes 6256, four figures, becauſe 68 is more than 62; and 12 multiplied by 16, makes but 192, three figures, for the reaſon aboveſaid, becauſe 19 is more than 16. Now for right naming the laſt figure, write them down; as thus, 75 by 63; now you multiply 5 by 3, that is 15, for which you, by vulgar Arithmetick, ſet down 5, and carry 1; therefore 5 is the laſt figure in the Product, and it is 4725.

PROB III. *Of Diviſion.*

One number being given to be divided by another, to find the Quotient.

Extend the Compaſſes from the Diviſor to 1, and the ſame extent will reach, the ſame way, from the Dividend to the Quotient; or, extend the Compaſſes from the Diviſor to the Dividend, the ſame extent ſhall reach, the ſame way, from 1 to the Quotient; as for Example.

Let 750 be a number given to be divided by 25 (the Diviſor) I extend the Compaſſes from 25 to 1, then applying of that extent the ſame way from 750, the other point of the Compaſſes will fall upon 30, the Quotient ſought: or you may ſay, as 25 is to 750, ſo is 1 to 30.

2. Let 1728 be given, to be divided by 12, ſay, as 12 is to 1, ſo is 1728 to 144. Extend the Compaſſes from 12 to 1, and the ſame extent ſhall reach the ſame way from 1728 to 144: or as before, as 12 to 1728, ſo is 1 to 144.

3. If the number be a decimal fraction, then you work as if it were an abſolute whole number; but if it be a whole number joyned to a decimal fraction, it is wrought here as properly as a whole number; Example, I would divide 111. 4 by 1. 728, extend the Compaſſes from 1. 728 to 1, the ſame extent applyed from 111. 4, ſhall reach to 64. 5: ſo again, 56. 4, being to be divided by 8. 75, the Quotient will be found to be 6. 45. for the extent from 8. 75, to 1 being laid the ſame way from 56. 4, will reach to 6. 45, the Quotient, *viz.* 6, and a decimal fraction 45. To reduce this decimal fraction to the vulgar fraction found by the Pen; the ſame extent of the Compaſſes laid the contary way from 45 the decimal fraction, gives $\frac{39}{75}$, the vulgar fraction found by the Pen, as is more apparent in the next Example.

In Diviſion by the Pen, the fraction remaining is the Numerator, and the Diviſor is the Denominator; to find which by the line, do thus with the ſame extent of the Compaſſes that wrought the Diviſion, laid the contrary way from the decimal fraction, gives the uſual fraction when you work by the Pen. Example. To divide 522 by 34. The extent from 34 to 1 reaches from 522 to 15.35; then the ſame extent laid the contrary way from 35, gives 12. 15, as by the Pen.

Now to know, of how many figures any Quotient ought to conſiſt, it is neceſſary to write the Dividend down, and the Diviſor under it, and ſee how often it may be written under it, for ſo many figures muſt there be in the Quotient; as in dividing this number 12231 by 27, according to the Rules of Diviſion, 27 may be written three times under the Dividend, therefore there muſt be 3 figures in the Quotient; for if you extend the Compaſſes from 27 to 1 it will reach from 12231 to 453, the Quotient ſought for.

Note, that in this, and alſo in all other Queſtions, it is beſt to order it ſo, as that the Compaſſes may be at the cloſeſt extent; for you may take a cloſe extent more eaſily and exactly than you can a large extent, as by experience you will find.

P R O B. IV.

To three numbers given to find a fourth in a direct proportion (or the Rule of Three Direct.

Extend the Compaſſes from the firſt number to the ſecond, that done, the ſame extent applied the ſame way from the third, will reach to the fourth proportional number required.

Example. *If the Circumference of a Circle, whoſe Diameter is* 7, *be* 22, *what Circumference ſhall a Circle have, whoſe Diameter is* 14?

Extend the Compaſſes from 7 in the firſt part, to 14 in the ſecond, and that extent applyed the ſame way from 22, ſhall reach to 44, the fourth proportional required; for ſo much ſhall the Circumference of a Circle be, whoſe Diameter is 14.——And the contrary, if the Circumference were given again.

Ex. 2. *If* 8 *foot of Timber be worth* 10 *ſhilling, how much is* 12 *foot worth?*

Extend the Compaſſes from 8 to 10 (either in the firſt part or ſecond) the ſame extent applyed the ſame way from 12, ſhall reach to 15; which is the anſwer to the queſtion; for ſo many ſhillings is 12 foot worth at that rate.

PROB. V.

Three numbers being given, to find a fourth in an inverſed proportion, (or the Back Rule of Three.)

Extend the Compaſſes from the firſt of the numbers given, to the ſecond of the ſame denomination, if that diſtance be applyed from the third number backwards, it ſhall reach to the fourth number ſought.

If 60 pence be 5 ſhillings, how much is 30 pence? *facit* 2. 5. two ſhillings, 5 tenths of a ſhilling, that is, being reduced, 2*s.* 6*d.*

Again, *If* 60 *Men can raiſe a Breſt-work of a certain length and breadth, in* 48 *hours, how long will it be ere* 40 *Men can raiſe ſuch another?*

Extend the Compaſſes from 60 to 40, numbers of like denomination, *viz.*

viz. of Men; this done, that extent applyed the contrary way from 48, will reach to 72, the fourth number you look for. Therefore I conclude, that 40 Men will perform as much in 72 hours, as 60 Men will do in 48 hours.

Note, that this *Back Rule of Three*, may for the moſt part, be wrought by the *Direct Rule of Three.*

If you do but duely conſider the order of the Queſtion, for you muſt needs grant, that fewer Men muſt have longer time, and the contrary; therefore the Anſwer muſt be, in proportion to the Queſtion, which might have been wrought thus as well: The extent from 40 to 60 will reach the ſame way, from 48 to 72 in direct proportion; or contrarily, as 60 is to 40, ſo is 72 to 48: which you ſee, is but turning the queſtion to its direct operation, according to the true reaſon of the queſtion.

Thus you have the way for the *Direct* and *Reverſe Rule of Three:* For the *Double Rule of Three*, and *Compound Rule* *of Three*, this is the Rule for it.

Always in the *Double Rule of Three* 5 terms are propounded, and a ſixth is required, three of which terms are of ſuppoſition, and two of demand ; now the difficulty is in placing them, which is beſt done thus, as in this *Example.*

Example. *If* 5 *Scholars ſpend* 20 l. *in* 3 *months, How many pounds will ſerve* 9 *Schotars for* 6 *months ?*

Note, here the terms of ſuppoſition are the firſt three, *viz.* 5, 20, and 3, and the terms of demand are 9 and 6.

Then next, for the right placing them, obſerve which of the terms of ſuppoſition is of the ſame denomination with the term required, as here the 20 *l.* is of the ſame denomination with the how many pounds required : let that always in the ſecond place, and the two terms of ſuppoſition one above another in the firſt place, and the terms of demand one above another in the laſt place, thus,

5 —— 20 —— 9
3 —— *pounds* —— 6

Then the work is performed by two ſingle *Rules of Three Direct*, thus:

Extend the Compaſſes from 5 to 20, the ſame extend applyed the ſame way from 9 ſhall reach to 36, a fourth; this is the firſt operation: Then as 3 to 36, the 4*th.* ſo is 6 to 72, the number of pounds required. By the Line of Numbers, the *Double Rule* is wrought as ſoon as the Compound: therefore I ſhall wave it now.

Four Queſtions and their Anſwers, to ſhew the various forms of working on the Line of Numbers.

Queſt. 1. *If* 12 *Men raiſe a Frame in* 10 *days, in how many days might* 8 *Men raiſe the like Frame?*

Reaſon tells me, that fewer Men muſt have longer time; therefore the work is thus, as 12 is to 8, ſo is 10 to 15, by the laſt Rule; or, as 8 to 10, ſo is 12 to 15.

Queſt. 2. *If* 60 *yards of Stuff, at* 3 *quarters of a yard broad, would hang a Room about; how many yards of Stuff, of half a yard broad, will ſerve to hang about the ſame Room?*

The work is thus; as 5 10*th.* to 7 10*th.* ½, ſo is 60 to 90, or, as 75 to 5, ſo is 60 to 90, wrought backwards.

Queſt. 3. *If to make a Foot Superficial* 12 *Inches in breadth, do require* 12 *Inches in length, the breadth being* 16 *Inches, how many Inches in length muſt I have to make a Foot Superficial?*

The work is thus; as 16 is to 12, ſo is 12 to 9, the number of Inches to make a Foot.

Queſt. 4. *If to make a Foot Solid, a Baſe of* 144 *Inches require* 12 *Inches in height, a Baſe being given of* 216 *Inches, how much in height makes a Foot Solid?*

The work then is, as 216 is to 144, ſo is 12 to 8: or otherwiſe thus, as 12 is to 216, ſo is 144 to 8, the heighth ſought.

PROB. VI.

To three numbers given, to find a fourth in a doubled Proportion.

This Problem concerns Queſtions of proportions between Lines and Superficies: now if the denominations of the firſt and ſecond terms be of Lines, then extend the Compaſſes from the firſt term to the ſecond (of the ſame kind or denomination) this done, that extent applyed twice, the ſame way from the third term, the moveable point will ſtay upon the fourth term required.

Example. *If the Content of a Circle whoſe Diameter is* 14, *be* 154, *what will the Content of a Circle be, whoſe Diameter is* 28 ?

Here 14 and 28 having the ſame denomination, *viz.* of Lines, I extend the Compaſſes from 14 to 28, then applying that extent the ſame way, from 154 twice, the movable point will fall on 616, the fourth proportional ſought, that is, firſt from 154 to 308, and from 308 to 616.

But if the firſt denomination be of ſuperficial content, then extend the Compaſſes unto the half of the diſtance between the firſt and ſecond of the ſame denomination; ſo the ſame extent will reach from the third to the fourth.

Example. *If the content of a Circle, being* 154, *have a Diameter that is* 14, *what*

what ſhall the Diameter of a Circle be, whoſe content is 616?

Divide the diſtance betwixt 154 and 616 into two equal parts, then ſet one foot in 14, the other ſhall reach to 28, the Diameter required.

The like is for Squares: *For if a Square, whoſe ſide is* 40 *foot, contain* 1600 *foot; how much ſhall a Square contain, whoſe ſide is* 60 *foot?*

Take the diſtance from 40 to 60, and apply it twice from 1600, and the moveable point will ſtay on 3600, the content ſought for.

PROB. VII.

Of three numbers given, to find a fourth in a triplicated proportion.

The uſe of this Problem conſiſteth in Queſtions of proportion, between Lines and Solids, wherein if the firſt and ſecond terms have denomination of Lines, then extend the Compaſſes from the firſt to the ſecond, that extent applyed three times from the third, will cauſe the moveable point to ſtay on the fourth proportional required.

Example. *If an Iron Bullet, whoſe Diameter is* 4 *Inches, ſhall weigh* 9 *pounds, what ſhall another Iron Bullet weigh, whoſe Diameter is* 8 *Inches?*

Extend the Compaſſes from 4 to 8, that extent applyed the ſame way three times from 9, the movable point will fall at laſt on 72, the fourth proportional and weight required, that is in ſhort, thus, as 4 to 8, ſo 9 to 18, ſo 18 to 36, ſo 36 to 72.

But if the two given terms be weight or contents of ſolids, and (the Diameter or ſide of a Square or) a Line is ſought for, then divide the ſpace between the two given terms of the ſame Denomination into three parts, and that diſtance ſhall reach from the third to the fourth proportional.

Example. Divide the ſpace between 9 and 72 in three parts, that third part ſhall reach from 8 to 4, (or from 4 to 8, as the queſtion was propounded, either augmenting or diminiſhing.)

Example. *If a Cube whoſe ſide is* 6 *Inches, contains* 216 *Inches, how many Inches ſhall a Cube contain, whoſe ſide is* 12 *Inches?*

Extend the Compaſſes from 6 to 12, that extent meaſured from 216 in the firſt part of the Line of Numbers three times, ſhall at laſt fall upon 1728, in the ſecond part of the Line of Numbers; for note, if you had begun on the ſecond part, you would at three times turning, have fallen beyond the end of the line; and the contrary, as above, holds here in Squares alſo.

PROB. VIII.

Betwixt two numbers given, to find a mean Arithmetically Proportional.

This may be done without the help of the Line of Numbers; nevertheleſs, becauſe it ſerves to find the next following, I ſhall here inſert it, though I thought to paſs both this and the next over in ſilence; yet to ſet forth the excellency of Number, I have ſet them down, and the Rule is this:

Add half the difference of the given terms to the leſſer of them, and that aggregate (or ſumme) is the Arithmetical mean required: or add them together, and the half ſumme is the ſame. Example.

Let 20 and 80 be the terms given, now if you ſubſtract one out of the other, their difference is 60, whoſe half difference 30, added to 20 the leſſer term, makes 50; and that is the Arithmetical mean ſought: alſo 20 and 80 is 100, the half is 50, as before.

PROB. IX.

Between two numbers given, to find a mean Muſically proportional.

Multiply the difference of the terms by the leſſer term, and add likewiſe the ſame terms together; this done, if you divide that product by the ſumm of the terms, and to the Quotient add the leſſer term; that laſt ſumm is the Muſical mean required. Or ſhorter, thus;

Multiply the terms one by another, and divide the product by their ſumm, and the Quotient doubled is the Muſical mean required.

Example. The numbers given being 8 and 12, multiplied together, make 96, that divided by 20, the ſumm of 8 and 12, the Quotient is $4^{8\,\circ}$, which doubled, is 9-6 ^{10} s, the Muſical mean required. This may be done by the Line of Numbers: Otherwiſe thus; Find the Arithmetical mean between 8 and 12, and then the Analogy or agreement is thus;

As the Arithmetical mean found, *viz.* 10, is to the greater term 12, ſo is the leſſer term 8 to the Muſical mean required, $9\frac{6}{10}$.

PROB. X.

Betwixt two numbers given, to find a mean Geometrically proportional.

Divide the ſpace on the Line of Numbers, between the two extreme Numbers, into two equal parts, and the point will ſtay at the mean proportional required. So the extreme numbers being 8 and 32, the middle point between them will be found to be 16.

PROB. XI.

Betwixt two numbers given, to find two means Geometrically proportional.

Divide the ſpace between the two

extreme numbers, into three equal parts; and the two middle points dividing the ſpace, ſhall ſhew the two mean proportionals. As for *Example*; Let 8 and 27 be two extremes, the two means will be found to be 12 and 18; which are the two means ſought for.

PROB. XII.

To find the Square-Root of any number under 1000000.

The Square-Root of every number is always the mean proportional between 1, and that number for which you would find a Square-root; but yet, with this general caution, if the figures of the number be even, that is, 2. 4. 6. 8. or 10. *&c.* then you muſt look for the unit (or 1) at the beginning of the line, and the number in the ſecond part, and the Root in the firſt part; or rather reckon 10 at the end to be the unit, and then both Root and Square will fall backwards toward the middle 1 in the ſecond length or part of the line: But if they be odd, then the middle 1 will be moſt convenient to be counted the unity, and both Root and Square will be found from thence forward towards 10. So that, according to this Rule, the ſquare of 9 will be found to be 3, the ſquare of 64 will be found to be 8, the ſquare of 144 to be 12, the ſquare of 1444 to be 38, the ſquare 57600 to be 240, the ſquare of 972196 will be found to be 986; and ſo for any other number.

Now to know of how many figures any Root ought to conſiſt, put a prick under the firſt figure, the third, the fifth, and the ſeventh, if there be ſo many; and look how many pricks, ſo many figures there muſt be in the Root.

PROB. XIII.

To find the Cube-Root of a Number under

1 0 0 0 0 0 0 0 0 0.
1 1 1 1

The Cube-root is always by the firſt of two mean proportionals between 1 and the number given, and therefore to be found by dividing the ſpace between them into three equal parts: ſo by this means, the Root of 1728 will be found to be 12, the Root of 17280 is near 26, the Root of 172800 is almoſt 56, although the point on the Rule repreſenting all the ſquare numbers, is in one place; yet by altering the unit, it produceth various points and numbers for their reſpective proper Root's. The Rule to find which unit is in this manner: You muſt ſet (or ſuppoſe to be ſet) pricks under the firſt figure to the left hand, the fourth figure, the ſeventh, and the tenth; now, if by this means, the laſt prick to the left hand ſhall fall on the laſt figure, as it doth in 1728, then the unit will be beſt placed at 1 in the middle of the line, and the Root, the Square, and the Cube will all fall forwards toward the end of the line.

But if it fall on the laſt but one, as it doth in 17280, then the unit may be placed at 10 in the beginning of the line, and the Cube in the ſecond length. But if the laſt prick fall under the laſt but two, as in 172800, it doth then place the unit always at 10 in the end of the line; then the Root, the Square and Cube will all fall backward, and be found in the ſecond part between the middle 1 and the end of the line. By theſe Rules it doth appear, that the Cube-root of 8 is 2, of 27 is 3, of 64 is 4, of 125 is 5, of 216 is 6, of 343 is 7, of 512 is 8, of 729 is 9, of 1000 is 10; As you may ſee by this Table of Square and Cube-roots.

Thus you have the chief Uſe of the Line of Numbers in general; and they that have skill in the Rule of Three, and a little knowledge in Plain Triangles, may very aptly apply it to their particular purpoſes; yet for their ſakes for whom it is intended, I ſhall enlarge to ſome more particular applications, in meaſuring all ſorts of Superficies and Solids; wherein I do judge it will be moſt ſerviceable to them that be unskilful in Arithmetick, as beforeſaid.

A Table *of the Square and Cubique Roots.*

Roots.	*Square.*	*Cube.*
1	1	1
2	4	8
3	9	27
4	16	64
5	25	125
6	36	216
7	49	343
8	64	512
9	81	729
10	100	1000
12	144	1728
26	676	17576
56	3136	175616
204	41616	8489664
439	192721	84604519
947	896809	849278123
1000	1000000	1000000000

CHAP.

CHAP. III.

The Uſe of the Line of Numbers, in meaſuring any Superficial Meaſure, as Board, Glaſs, Plaiſtering, Paving, Painting, Flooring, &c.

THE ordinary Meaſure, and moſt in uſe, is a *Two-foot Rule* divided into 24 Inches, and every Inch into 8 Parts, that is, Halfs, Quarters, and Half-quarters; but theſe parts not agreeing with the parts on the Line of Numbers, which are Decimals or tenth parts, has bred very much trouble; and there cannot be exactneſs without taking of ſmall parts, as Half-quarters of Inches, or elſe uſing of Reduction; and it is alſo as troubleſome by Arithmetick as by the Line of Numbers. To avoid which, I would adviſe either to meaſure altogether by Foot-meaſure, that is, a Foot divided into 1000 parts, (or rather, as is ſufficient for ordinary uſe, 100) and then the diviſions on the numbers will agree fitly to the parts on your Rule, without any trouble for Fractions; for ſo doing, Fractions do become whole Numbers, as it were, and are wrought accordingly: But if you uſe it not in meaſuring, yet you may have it ſet for to help you for the ready reducing of ſuch Numbers as ſhall require it, though I ſhall apply it to Inches alſo, as it is commonly uſed, that it may appear uſeful both ways, accordingly as any Man ſhall be affected.

The like Reaſon holdeth for Inches, Yards, Ells, and Perches, or any other meaſure; for thereby the Work is made more eaſie, as ſhall appear anon.

Firſt, by Foot-meaſure only.

PROB.

PROB. I.

The breadth of any Oblong Superficies, as a Table, Grave-ſtone, or the like, given in Foot-meaſure, to find how much in length makes one Foot.

Extend the Compaſſes from the breadth in Foot-meaſure to 1, the ſame extent applied the ſame way from 1, ſhall reach to the length required, to make one Foot Superficial in Foot-meaſure.

Example; *At* 8 *tenths broad.*

Set one point of the Compaſſes in 8, and extend the other point to 1; the ſame extent being laid the ſame way from 1, ſhall reach to 1.25, the length required, being one Foot, and 25 parts of a hundred: For 1.25 multiplied by 8, is 100.0, or juſt one Foot in Decimals.

PROB. II.

The breadth and length of any Superficies given in Foot-meaſure, to find

find the ſuperficial Content in Foot-meaſure.

Extend the Compaſſes from 1 to the breadth, the ſame extent applied the ſame way from the length in Foot-meaſure, ſhall reach to the ſuperficial Content in Foot-meaſure.

Examp. *At* 8 *tenths broad, and* 15 *foot long.*

Extend the Compaſſes from 1 to 8, the ſame extent laid the ſame way from 15 foot the length, ſhall reach to 12 foot, the ſuperficial content required.

Again, at 1.75 *broad, and* 25.30 *long.*

Set one point of the Compaſſes in 1, and open the other to 1.75, then the ſame extent laid the ſame way from 25.30, will reach to 44 feet 275 parts, the ſuperficial content required.

Note, The 275 parts counted on Foot-meaſure, right againſt it on inches, is 3 inches 3 tenths.

PROB.

PROB. III.

The breadth of any Oblong Superficies being given in inches, to find how many inches in length make one foot.

The extent from the inches broad to 12 being laid the ſame way from 12, ſhall reach to the inches long to make 1 foot.

Examp. *At* 9 *inches broad.*

Set one point in 9, open the other to 12, then the ſame extent laid the ſame way from 12, reaches to 16 inches, the length required to make 1 foot ſuperficial: for 9 multiplied by 12 is 144, the number of ſuperficial inches in one foot.

PROB. IV.

The breadth and length of an Oblong Superficies given in inches, to find the ſuperficial content in like inches.

Examp. *At* 30 *inches broad, and* 183 *inches long.*

Set one point of the Compaſſes in 1, and open the other to 183, then the ſame extent laid the ſame way from 30, ſhall reach to 5490, the true content in inches.

Now to call this 5490, and no more or leſs, obſerve, as 183 is two figures more than 1, ſo muſt 5490 be two figures more than 30, as is obſerved in the Rule of Multiplication.

PROB. V.

The length and breadth given in inches, to find the content in Superficial Feet.

The extent from 144 (the inches in 1 foot) to the breadth in inches, being laid the ſame way from the length in inches, ſhall reach to the content in feet.

Examp. *At* 30 *inches broad, and* 183 *long.*

Set one point in 144, and open the other to 183, the ſame extent laid the ſame way from 30, reaches to 38 foot $\frac{12}{000}$, the near content in feet required.

PROB. VI.

The breadth given in inches, and the length in feet, to find the content in Superficial Feet.

The extent from 12 to the breadth in inches, ſhall reach the ſame way from the length in feet to the ſuperficial content in feet required.

Examp. *At* 30 *inches broad, and* 15 *foot* 3 *inches long.*

Set one point in 12, and open the other to 30, the breadth in inches; then the ſame extent laid the ſame way from 15 foot 3 inches the length, reaches to 38 foot 1 inch and ½, the true content.

PROB. VII.

The length and breadth being given in feet and inches, to find the ſuperficial content in feet and inches.

As 1 is to the breadth or length in feet and inches, ſo is the length or breadth in feet and inches to the ſuperficial content in like feet and inches.

Examp. *At* 18 *foot* 9 *inches broad, and* 30 *foot* 7 *inches long.*

Set one point always in 1, open the other to the (length or) breadth 18 foot 9 inches; then the ſame extent laid the ſame way from 30 foot 7 inches the length, reaches to 573 foot 5 inches, the ſuperficial content.

Note, If you have the Line of Numbers divided into twelves for inches, as before-ſaid, you may work this queſtion more readily and truly, as I have often-times made them for my own uſe and others alſo.

Note, That how broad ſoever any Superficies is, ſo much is there in a foot long of that Superficies.

Example: If a Board be 3 feet 9 inches broad, there is 3 feet 9 inches in every foot long of that Board; therefore (3 feet 9 inches, or) the breadth in feet and parts, multiplied by the length in feet and parts, give the ſuperficial content.

PROB. VIII.

Of a Circle and his parts, as Diameter, Circumference, Square-equal, and Square within, and Area of a Circle.

For the ready finding of any of theſe, any one being given, there is found out five numbers, in whoſe places on the Line may be ſet five Center-pins for the more ready finding of them, and readineſs to uſe, which are as follow, *viz.*

Diameter	10.000
Circumference	31.416
Square-equal	8.862
Square within	7.071
Area or Content	78.538

Thus if the Diameter of a Circle be 10 inches, then the Circumference is near 31 inches, and 416 parts of 1000.

The ſide of the Square-equal is 8 inches 862.

The ſide of the Square within is 7.071.

The Area or content is 78 inches, 538 parts.

And any one of theſe being given, all the other four may be readily found by the Line of Numbers, as followeth.

Any Diameter of a Circle given, to find the Circumference, &c.

The extent from 10 a fixed Diameter, to any other Diameter given, ſhall reach the ſame way from 31.416 the fixed Circumference, to the Circumference required for the given Diameter. And from the fixed ſide of the Square-equal, to the required ſide of the Square-equal. And from the fixed ſide of the Square within, to the required ſide of the Square within, *&c.*

1. Examp. *Let the given Diameter of a Circle be* 15, *what is the Circumference anſwerable to it?* &c.

Set one point of the Compaſſes in 10 the fixed Diameter, and the other in 15 the given Diameter; then the ſame extent applied the ſame way from 31.416 the fixed Circumference, ſhall reach to 47.14 the Circumference required.

2. *To find the ſide of a Square-equal to a Circle of* 15 *inches Diameter.*

Alſo the ſame extent applied the ſame way from 8.862, the fixed number for the ſide of the Square-equal, ſhall reach to 13.30, the ſide of the Square-equal to the Circle required.

3. *To find the ſide of the Square-within.*

The ſame extent from 10 to 15 being laid the ſame way from 7.071 the fixed ſide of the Square-within, ſhall reach to 10.61 the ſide of the Square within in a Circle of 15 inches Diameter required.

4. *To find the Area or Content of the Circle whoſe Diameter is 15 inches.*

The ſame extent from 10 to 15 being twice repeated, the ſame way from 78.538 will reach to 176 inches and 7 tenths, the Area of a Circle of 15 inches Diameter.

PROB. IX.

The Circumference of any Circle being given, to find the Diameter, the Square-equal, or Square within, and the Area.

Examp. *If the Circumference given be* 47.14, *what is the Diameter, the ſide of the Square-equal, or Square within, and Area.*

1. Set one point in 31.416 the fixed Circumference, and the other in 47.14 the given Circumference;

then the ſame extent laid from 10 the fixed Diameter, ſhall reach to 15 the Diameter required for a Circle of 47.14 Circumference.

2. Alſo the ſame extent laid from 8.862 the fixed ſide of the Square-equal, ſhall reach the ſame way to 13.30 the ſide of the Square-equal required.

3. Alſo the ſame extent laid the ſame way from 7.071, ſhall reach to 10.61, the ſide of the Square within in a Circle of 15 inches Diameter required.

4. The ſame extent from 31.416 the fixed Circumference, to 47.14 the given Circumference, being twice repeated the ſame way from 78.538, the fixed Area for 10 inches Diameter ſhall reach to 176 inches and 7 tenths, the Area of a Circle of 47.14 inches about.

PROB.

PROB. X.

The Area of any Circle being given, to find the Diameter, Circumference, Square-equal, or the ſide of the Square within required.

The exact middle, or half-diſtance meaſured on the Line of Numbers, betwixt the fixed Area 78.538 and the given Area, ſhall reach from the fixed Diameter to the enquired Diameter; and from the fixed Circumference to the enquired Circumference, and from the ſides of the fixed Square-equal or within, to the enquired ſides of the Squares-equal or within.

Examp. *Let the given Area be* 176 *inches* $\frac{7}{10}$.

The exact middle between 78.538 the fixed Area, for a Circle of 10 inches Diameter, and 176 inches and 7 tenths the given Area, meaſured on a Line of Numbers.

1. Then that extent laid the ſame way from 10 the fixed Diameter, reaches to 15 the enquired Diameter.

2. Alſo the ſame extent laid the ſame way from 31.416 the fixed Circumference, gives 47.14 the Circumference required.

3. Alſo the ſame extent laid the ſame way from 8.862 the fixed ſide of the Square-equal, reaches to 13.30, the ſide of the Square-equal required.

4. Laſtly, The ſame extent laid the ſame way from 7.071 the fixed number for the ſide of the Square within, ſhall reach to 10.61 the ſide of the Square within required for a Circle whoſe Area is 176 inches and 7 tenths.

PROB. XI.

Having the Area of any Circle, to find the ſide of a Square-equal to it.

The Square-root of the given Area (found by *Prob.* 12. of the 11th *Chapter*) is always the ſide of the Square-equal to the Circles Area given; thus the Square-root of a Circle whoſe Area is 144 is 12, the Square-root of 144.

PROB.

PROB. XII.

To find the Content of a Circle two ways.

Multiply the Diameter by it ſelf, and multiply that product by 11, and divide this laſt product by 14, and the Quotient ſhall be the Content required.

Or elſe multiply half the Diameter and half the Circumference together, and the Product is the Content required.

PROB. XIII.

How to meaſure a Circle, a Semicircle, or a quarter of a Circle, or any part that goeth to the Centre of the ſuppoſed Circle.

Firſt for a Circle.

Take half the Diameter and half the Circumference, and meaſure it then as an Oblong Square; for the half Circle take half the Diameter and half the Semicircumference, and do likewiſe. Thirdly, for the quarter of a Circle, take half the Arch of that quarter, and the Radius or Semidiameter of the whole Circle, and work as you would do with an oblong-ſquare piece, and you ſhall have your deſire.

PROB. XIV.

How to meaſure a Triangle.

Take half the Baſe, and the whole Perpendicular, and work with them two as if it were an oblong-ſquare figure, or you may take the whole Baſe, and half the Perpendicular.

Or, by the Line of Numbers, the extent from 2 to the Baſe ſhall reach from the Perpendicular to the Content.

PROB. XV.

How to meaſure a Rhombus, or a Rhomboides.

A Rhombus is a Diamond like figure, as a quarry of Glaſs is, containing four equal ſides, and two equal oppoſite angles: but a Rhomboides is a figure made of two equal oppoſite ſides, and two equal oppoſite angles:

And to meaſure them, you muſt take any one ſide, and the neareſt diſtance from that ſide to its oppoſite ſide for the other ſide, and then reckon it as an oblong-ſquare.

PROB. XVI.

How to meaſure a Trapezium.

A Trapezium is [illegible] figure comprehended of four unequal ſides, and of four unequal angles; and before you can meaſure it, you muſt reduce it into two Triangles, by drawing a line from any two oppoſite corners, then deal with it as two Triangles; or you may ſave ſome work thus, the line you draw from corner to corner will be the common Baſe to both Triangles; then ſay, as 1 is to half the Perpendiculars of both the Triangles put together, ſo the whole Baſe to the Content.

PROB. XVII.

How to meaſure a many-ſided irregular figure, or Polygon.

You muſt reduce it into Triangles or to Trapeziums, by drawing of lines from convenient oppoſite corners; and then the work is all one with that of the laſt Problem.

PROB. XVIII.

How to meaſure a many-ſided regular figure, commonly call'd a Regular Polygon.

Meaſure all the ſides, and take the half of the ſumm of them for one ſide of a ſquare, and the neareſt diſtance from the centre of the Polygon to the middle of one of the ſides for the other ſide of a ſquare; and with them two numbers work as if it were a ſquare-oblong figure, and it will give the content of the Polygon deſired.

PROB. XIX.

How to reduce Feet into Yards, Ells, or other Parts.

Firſt for Yards, If *9* Foot make 1 Yard, how many ſhall 36 Foot make?

The extent from *9* to 2 will reach from 36 to 4, for ſo many Yards is 36 Foot. But if you were to meaſure any quantity by the Yard, as the Plaiſtering or Painting of a Houſe, then I would adviſe you to have a Yard to be divided into a 100 parts (which is as near as commonly Workmen go to, or elſe into 1000, if you do require more exactneſs) and meaſure all your lengths and breadths with that, and ſet them down thus, 2.25 (or by 1000, thus, 2.250) and the length thus 10.60, and multiply them together, and the product is the true content of that long ſquare: The like holds for Ells, or Poles, Furlongs, or any other kind of meaſure. Again, for a Yard in length; If 3 Foot make 1 Yard, then what ſhall 30 make? It maketh 10: Or the contrary, If 10 yards make 30 foot, what ſhall 12 make? The extent from 10 to 12 will reach from 30 to 36 Foot; but if it be given in Feet or Inches, then ſay, as 9 to the breadth, ſo is the length in Feet and Inches (or Decimal Parts) to the Content in Yards required.

CHAP. IV.

The Uſe of the Line of Numbers, in meaſuring of Land by Perches and Acres.

PROB. I.

Having the breadth and length of an Oblong Superficies given in Perches, to find the Content in Perches.

AS one Perch to the breadth in Perches, ſo the length in Perches to the content in Perches.

Examp. As 1 is to 30, ſo is 183 to 5490 perches.

PROB. II.

Having the length and breadth in Perches, to find the Content in ſquare Acres.

As 160 to the breadth in perches, ſo is the length in Perches to the content in Acres.

As 160 unto 30, ſo is 183 to 34.31 (in Acres and 100 Parts.)

PROB. III.

Having the length and breadth of an oblong Superficies given in Chains, to find the content in Acres.

It being troubleſome to divide the content in Perches by 160, we may meaſure the length and breadth by Chains, each Chain being four Perches in length, and divided into a hundred links, then the work will be more eaſie in Arithmetick or by the Rule; for as 10 to the breadth in Chains, ſo the length in Chains to the content in Acres.

Examp. As 10 to 7.50, ſo is 45.75 to 34.81 (100 parts of an Acre.)

PROB. IV.

Having the Baſe and Perpendicular of a Triangle given in Perches, to find the content in Acres.

If the Perpendicular go for the length, and the whole Baſe for the breadth, then you muſt take half of the oblong for the content of the triangle, by the *Second Problem*, as 160 to 30, ſo is 183 to 34.31; or elſe, without halfing, ſay, As 320 to the Perpendicular, ſo is the Baſe to the content in Acres; As 320 unto 30, ſo is 183 to 17.15.

PROB. V.

Having the Perpendicular and Baſe given in Chains, to find the content in Acres.

As 20 to the Perpendicular, ſo is the Baſe to the content in Acres.

As 20 to 7.50, ſo is 45.75 to 17.15 parts.

PROB. VI.

Having the content of a Superficies after one kind of Perch, to find the content of the ſame Superficies according to another kind of Perch.

As the length of the ſecond Perch is to the firſt, ſo is the content in Acres to a fourth number, and that fourth number to the content in Acres required. Suppoſe a Superficies be meaſured with a Chain 66 feet, or with a Perch of 16 ½, and it contains 34. 31, and it be demanded how many Acres it would contain if it were meaſured with a Perch of 18 foot. Theſe kind of Proportions are to be wrought by the Backward *Rule of Three*, after a duplicated proportion: wherefore I extend the Compaſſes from 16. 5 unto 18.0; and the ſame extent doth reach backward, firſt from 34. 31 to 31. 45, and then from 31. 45 to 28. 84 the content in thoſe larger Acres of 18 foot to a Perch.

PROB. VII.

Having the plot of a Field with the content in Acres, to find the Scale by which it was plotted.

Suppoſe a Plain contained 34 Acres 31 Centeſms, if I ſhould meaſure it with a Scale of 10 in an inch, the length ſhould be 38 Chains and 12 Centeſms, and the breadth 6 Chains and 25 Centeſms; and the content, according to that dimenſion, would, by the III^d *Problem* of this *Chapter*, be

found

found to be 23.82, whereas it ſhould be 34.31; therefore to gain the truth, I divide the diſtance between 23.82 and 34.31 into two equal parts, then ſetting one point of the Compaſſes upon 10, the ſuppoſed true Scale, I find the other to extend to 12, which is the length of the Scale required.

PROB. VIII.

Having the length of the Oblong, to find the breadth of the Acre.

As the length in perches to 160, ſo is one Acre to the breadth in Perches. As 40 to 160, ſo is 1 to 4. Again, As 50 to 160, ſo is 1 to 3.20, ſo is 2 to 6.40; or again, if you meaſure by Chains, As the length in Chains to 10, ſo is 1 Acre to his breadth in Chains; as 12.50 unto 10, ſo 1 to 0.80; or if the length be meaſured by Foot-meaſure, then as the length in Feet unto 43560, ſo is 1 Acre to his breadth in Foot-meaſure.

So the length of the Oblong being 792 Feet, the breadth of 1 Acre will be found to be 55 foot, the breadth of 2 Acres 110 feet.

The Uſe of the following Table is to ſhew you how many Inches, Centeſms of a Chain, Feet, Yards, Paces, Perches, Chains, Acres there is in a Mile, either long or ſquare, or conſequently any of them all, in any of the other that is leſs: As for Example, I would know how many Inches there is in a long Perch; I look on the uppermoſt row for Perches, and in the next row under I find 198 for the quantity of Inches in a long Perch. But if I would know how many Inches there is in a ſquare Perch, then look for Perch on the left hand, and in the Inch column you have 39204; for if you multiply 196 by 196, it will produce 39204.

A neceſſary Table *for Menſuration of Superficial Meaſure.*

	Inch.	*Centeſm.*	*Feet.*	*Yard.*	*Pace.*	*Perch.*	*Chain*	*Acre.*	*Mile.*
Inch.	(1)	7 92	12	56	60	198	792	7920	63360
Centeſ.	62 7264	(1)	1.515	4 545	7 575	25	100	1000	8000
Feet.	144	2 295	(1)	3	5	16 5	66	600	5280
Yards.	1296	20 655	9	(1)	1 66	5 50	22	220	1760
Pace.	3600	57 381	25	2 778	(1)	3 30	13 2	132	1056
Perch.	39204	625	272.25	30 25	10.89	(1)	4	40	320
Chain.	627264	10000	4356	484	174.24	16	(1)	10	80
Acres.	6272640	100000	43560	4840	1742.4	160	10	(1)	8
Mile.	4014489600	64000000	27878400	3097600	1115136	102400	6400	640	(1)
Square.	*Inches.*	*Centeſms.*	*Feet.*	*Yards.*	*Paces.*	*Perch.*	*Chain*	*Acre.*	*Mile.*

The like is for any other number in the whole Table, and is of very good Uſe to reduce one Number into another, or one ſort of Meaſure into another; as Inches into Feet, and Feet into Yards, and Yards into Perches, and Perches into Chains, and Chains into Acres, and Acres into Miles, or the contrary, either long-wiſe or ſquare-wiſe, as is well known to them that have occaſion for theſe Meaſures. Thus much ſhall ſuffice for *Superficial Meaſure*, the Practice of which will make it plain to any ordinary Capacity.

CHAP. V.

The Uſe of the Line of Numbers, in Meaſuring any Solid Meaſure, as Timber, Stone, or ſuch like.

PROB. I.

The breadth and thickneſs of any Solid given, to find the ſide of a ſquare that ſhall be equal in Area to it.

DIvide the ſpace on the Line of Numbers, between the breadth and thickneſs, into two equal parts, and the Compaſs-point ſhall ſtay at the ſide of the Square-equal required.

Examp. *At* 6 *inches thick, and* 18 *inches broad.*

The exact middle between 6 and 18 on a true Line of Numbers, will be at 10.393, which is a Geometrical mean proportion between 6 and 18, and the ſide of a Square-equal, to a piece 6 inches thick, and 18 inches broad; for 10.393 ſquared, *viz.* multiplied by 10.393, 10.393, produceth 108 very near, being the product of 6 times 18.

PROB. II.

The ſide of the ſquare of any Solid given, to find how much in length makes a Foot of Solid or Timber-meaſure, by Foot-meaſure or Inches.

The extent from the ſide of the ſquare given in Foot-meaſure to 1, being twice repeated or laid the ſame way from 1, ſhall reach to the length required to make a foot ſolid.

Examp. *At* 2 *foot and* 20 *parts ſquare, how much in length makes one foot ſolid.*

The extent from 2.20 to 1 being laid or extended twice the ſame way from 1, will ſtay at 0.2065, the true length to make a foot ſolid.

For 2.20 the ſide of the ſquare, multiplied by it ſelf, is 4.84; then 4.84 multiplied by 2065, the product is 999.46, which is near one foot ſolid.

2. If the ſide of the ſquare be given in inches, then the extent from the inches ſquare to 12 being twice re-

peated the ſame way from 12, ſhall reach to the inches long to make one foot.

Examp. *At* 15 *inches ſquare.*

Set one point in 15, and the other in 12, the ſame extent laid twice the ſame way from 12, ſhall reach to 7 inches 68 parts, the true length to make one foot ſolid. For 15 inches ſquared is 225.

Then 225 multiplied by 7.68, produceth 1728, the cube-inches in a foot ſolid.

3. For ſmall Timber work thus:

The extent from the inches ſquare to 12 being laid twice the ſame way from 1, ſhall reach to the feet and parts in length to make one foot ſolid.

Examp. *At 3 inches and $\frac{1}{2}$ ſquare.*

The extent from 3 inches and $\frac{1}{2}$ to 12 being laid twice the ſame way from 1, ſhall ſtay at 11 foot 76 parts, the length in feet to make a foot ſolid.

For 3 $\frac{1}{2}$ ſquared is 12.25; which multiplied by 11 foot 76 parts, produceth 144, the number of long inches in a foot ſolid; for 144 pieces a foot long, and 1 inch ſquare, is a true ſolid foot, or 1728 cube inches.

PROB. III.

The breadth and thickneſs of any Solid given in Inches or Foot-meaſure, to find the length of one foot ſolid.

1. The extent from 12 to the breadth in inches, ſhall reach from the depth in inches to a fourth.

2. The extent from that fourth number to 12 laid the ſame way from 12, ſhall reach to the inches long to make one foot ſolid.

Exam. *At* 20 *inches broad, and* 9 *inches thick, how many inches long makes one foot?*

1. The extent from 12 to 9 the inches thick, being laid the ſame way from 20 the inches broad, gives 14.98 a fourth number.

2. The extent from 14.98 to 12 being laid the ſame way from 12, gives 9 inches and 60 parts, the length to make one foot ſolid.

But for ſmall Timber work thus:

1. The extent from 1 to the

breadth, ſhall reach from the depth to a fourth.

2. The extent from that fourth number to 12, laid the ſame way from 12, gives the length in feet and parts to make one foot ſolid.

Examp. *At* 3 *inches thick,* *and* 5 *inches broad.*

1. The extent from 1 to 3 the thickneſs, laid the ſame way from 5 inches the breadth, reaches to 14. 95 a fourth.

2. The extent from 14.95 the fourth to 12, being laid the ſame way from 12, gives 9 foot 60 parts, the length in feet, to make one foot ſolid.

For the product of 20 multiplied by 9 is 180, and 180 multiplied by 9 inches 6 tenths, will produce 1758 the cube inches in one foot.

So alſo for the ſmall piece:

The 3 inches multiplied by 5 is 15; then 15 multiplied by 9 foot 60 parts, will produce 144, as before, the long inches in a foot ſolid.

PROB.

PROB IV.

1. *At any ſquareneſs, or breadth and thickneſs given, to find how much is in a foot long.*

The extent from 12 to the inches ſquare, laid the ſame way from the inches ſquare, gives the quantity in one foot long.

Examp. *At* 4 *inches ſquare.*

Set one point of the Compaſſes in 12, and the other point in 4; the ſame extent laid the ſame way from 4 the inches ſquare, gives 1 inch and 33 parts, the quantity in 1 foot long.

Which being multiplied by the length of the Tree, gives the near true content.

2. If the Timber is not ſquare, then thus:

The extent from 12 to the breath, ſhall reach the ſame way from the depth or thickneſs to the quantity in one foot long.

Examp. *At* 14 *inches broad, and* 8 *inches thick.*

The extent from 12 to 14 inches the

breadth, ſhall reach the ſame way from 8 the inches thick, to 9 inches and 33 parts, the quantity or content in one foot long.

Then if the Tree be 20 foot long, 20 times ſo much is 15 foot 7 inches $\frac{2}{3}$, the true content.

PROB. V. (being moſt uſed.)

The ſide of the ſquare given in inches, and the length in feet, to find the content in feet and parts required.

The extent of the Compaſſes from 12 to the inches ſquare, being twice repeated the ſame way from the length, gives the true content of the Tree required.

Examp. *At 15 inches ſquare, and 20 foot long, how much Timber is there?*

Set one point in 12, and extend the other to 15, the inches ſquare.

Then the ſame extent laid twice the ſame way from 20 the feet long, ſhall reach to 31 foot 3 inches, the true content required.

For 15 inches, or 1 foot 3 inches ſquared (or multiplied by it ſelf) is

1.6.9,

1, 6. 9, or 1 foot 6 inches $\frac{3}{4}$, and 20 times ſo much is 31 foot 3 inches.

PROB. VI.

The breadth and thickneſs of any piece given in inches, and the length in feet, to find the ſolid content in feet.

1. The extent from 12 to the breadth in inches, laid the ſame way from the depth in inches, gives a fourth number.

2. The extent from that fourth number to 12 ſhall reach the ſame way from the length to the content required.

Examp. *At* 8 *inches thick, and* 13 *inches broad, and* 19 *foot long, what is the ſolid content in feet.*

1. The extent of the Compaſſes from 12 to 8 inches the thickneſs, being laid the ſame way from 13 inches the breadth, ſhall reach to 8.66 a fourth.

2. The extent from 12 to that fourth, being laid the ſame way from 19 foot the length, gives 13 foot 73,

(or near 9 inches) the true content in feet and parts.

For 8 inches the thickneſs, multiplied by 1 foot 1 inch the breadth, is 0 *f.* 8 *inc.* 8. 12 *pts.* then 19 foot the length, multiplied by 0 *f.* 8 *inc.* 8. 12, makes 13 foot, 8 inches, and 8. 12, the exact content of a piece 8 inches thick, 13 inches broad, and 19 foot long.

PROB. VII.

The length, breadth and depth of any ſolid given in inches, to find the ſolid content in cube inches.

1. The extent from 1 to the breadth in inches, being laid the ſame way from the depth in inches, ſhall reach to a fourth.

2. The extent from 1 to that fourth, ſhall reach the ſame way from the length in inches to the content in cube-inches required.

Examp. *At* 9 *inches thick,* 15 *inches broad, and* 40 *inches long.*

1. Set one point of the Compaſſes in 1, and the other in 9 the inches

thick, then the ſame extent laid the ſame way from 15 the breadth in inches, gives 13.50 a fourth.

2. Then the extent from 1 to 13.50 the fourth, laid the ſame way from 40 the length in inches, gives 5400 the content in inches.

For 9 multiplied by 15 is 135, and 135 multiplied by 40, is 5400.

PROB. VIII.

The length, breadth and depth of a great ſolid given in feet and decimals, or in feet and inches, to find the content in feet and parts.

1. The extent from 1 to the breadth in feet and parts, ſhall reach the ſame way from the depth in feet and parts to a fourth.

2. The extent from 1 to that fourth being laid the ſame way from the length in feet and parts, ſhall reach to the content in feet and decimal parts required.

Examp. *Suppoſe a Ciſtern be* 3 *foot* 75 *parts (or* 3 *foot* 9 *inches) broad, and*

and 4 *foot* 50 *parts* (*or* 4 *foot* 6 *inches*) *deep, and* 7 *foot* 66 *parts, or* 8 *inches long, how many ſolid feet will it hold?*

1. The extent from 1 to 3.75 being laid the ſame way from 4.50 gives 16.875 for a fourth.

2. The extent from 1 to 16.875 the fourth, being laid the ſame way from 7.666 the length, gives 129 foot 3637 parts, or 4 inches and $\frac{1}{3}$.

For 3.75 multiplied by 4.5, gives 16.875 the fourth; then 16.875 multiplied by 7.66 the length, gives 129 foot, 364 parts, or 4 inches and $\frac{1}{3}$, which you may reduce by a look of your eye on inches and foot-meaſure laid one by the other on your Rule.

Note, Every 6 Foot is a full Beer Barrel; therefore 129 foot is 1.1 Barrels and $\frac{1}{2}$.

Note alſo, If the ſpace on the Line of Numbers between every figure is divided into 12 proportional parts by ſmall pricks, they will repreſent inches, and be very ready in uſe, for any Learner eſpecially.

CHAP.

CHAP. VI.

To meaſure Round Timber, by having the Diameter given in Foot-meaſure, or Inches, and the Length in Feet.

PROB. I.

At any Diameter given in inches, to find how many inches in length will make one foot ſolid.

THE extent from the Diameter in inches to 13.54 (the Diameter when 1 foot long makes 1 foot of Timber) being laid twice the ſame way from 12, ſhall reach to the inches in length to make 1 foot.

Examp. *At* 10 *inches Diameter.*

The extent from 10 to 13.54 being laid twice the ſame way from 12, gives 22 inches, the length to make 1 foot ſolid.

For 78.54 the Area of a Circle of 10 inches diameter, multiplied by 22, produceth 1728, the cube-inches in 1 foot ſolid.

PROB. II.

The Diameter given in foot-meaſure, to find how much in length make one foot ſolid.

The extent from the Diameter in foot-meaſure to 1.128 (the Diameter in foot-meaſure, when one foot long makes 1 foot) being laid twice the ſame way from 1, gives the length in foot-meaſure to make 1 foot ſolid at that given Diameter.

Examp. *At* 0.833 *Diameter, how much in length makes* 1 *foot ſolid.*

The extent from 0.833 the given Diameter to 1.128, laid twice the ſame way from 1, gives 1.833 the near length in foot-meaſure to make 1 foot ſolid.

For 54.56 the Area of a Circle whoſe diameter is 0.833 being multiplied by 1.833, the product is 1000.045, the decimals in 1 foot ſolid.

PROB. III.

The diameter given in inches, to find how much is in 1 *foot long.*

The extent from 13.54 to the diameter in inches given, being twice repeated from 12, ſhall reach to the inches of Timber contained in one foot long.

Or the ſame extent laid twice the ſame way from 1, will reach to the feet and inches contained in one foot long.

Examp. *At* 8 *inches diameter, how much is in one foot long.*

Set one point of the Compaſſes in 13.54, and open the other to 8, the given diameter in inches.

Then the ſame extent laid twice the ſame way from 12, gives 41 inches $\frac{3}{4}$ the long inches of Timber in one foot long, 144 being one foot. Or the ſame extent laid twice the ſame way from 1, reaches to 0.348, 1000 being 1 foot.

Then 0.348 multiplied by the length of the Tree in feet, gives the true content.

Examp. *At* 15 *inches diameter, and* 20 *foot long.*

The extent from 13.54 to 15 being laid twice the ſame way from 12, gives 14 inches 66 parts; or laid twice from 1, gives 1 foot 223.

Then 20 times ſo much is 24 foot 56 parts, or 6 inches $\frac{3}{4}$.

Alſo 20 times 14.66 inches, is 293.20 inches, 12 being 1 foot, which divided by 12, makes 24 foot near 7 inches.

PROB. IV.

The diameter in inches being given of any Tree or Cylinder, and the length in feet, to find the content in feet.

The extent from 13.54 to the diameter in inches, being laid twice the ſame way from the length, gives the content in feet.

Examp. *At* 15 *inches diameter, and* 20 *foot long.*

The extent from 13.54 to 15 being laid twice the ſame way from 20, gives 24 foot and 42 parts, the content in feet.

Note, That right againſt 42 in feet-meaſure is 5 inches in the inch-meaſure. For the Area of a Circle 15 inches diameter is 177, and 20 times this is 3540, which divided by 144, hath 24 foot 84 cube-inches a Quotient (for 7 inches the near content.)

PROB. V.

The diameter given in inches, and the length in inches, to find the content in inches.

The extent from 1.128 to the diameter in inches being laid twice the ſame way from the length in inches, gives the true content in cube-inches.

Examp. *A Well, or a Tub of* 40 *inches diameter, and* 50 *inches deep.*

The extent from 1.128 to 40 the inches diameter, being laid twice the ſame way from 50 the length in inches, gives 62900 inches, the near content in cube-inches.

Or the extent from 1.128 to 3 foot 33 parts (or 4 inches) the given diameter laid twice from 4 foot 166 (or 4 foot 2 inches) gives 36 foot 40 parts, the content in feet and parts.

For 36 times 1728 inches is 62208 inches; then 692 inches in the 40 parts over being added, makes 62900 the cube-inches in that Cylinder.

PROB. IV.

Having the Circumference given in inches, to find how many inches long makes one foot, or how many feet and parts long.

The extent from the Circumference (or girt) about any Cylinder given in inches, to 42. 54 (the inches about, when one foot long makes one foot ſolid) the ſame extent laid twice the ſame way from 12, reaches to the inches long, to make one foot ſolid meaſure.

And the ſame extent laid twice the ſame way from 1, gives the feet long to make one foot ſolid.

Examp. *Suppoſe a Tree be* 30 *inches about, how many inches, or feet and inches long, makes one foot ſolid meaſure.*

The extent from 30 inches the girt, to 42. 54 laid twice the ſame way from 12, gives 24 inches $\frac{1}{10}$, the inches long to make one foot.

Alſo the ſame extent laid twice the ſame way from 1, gives 2 foot 01, or $\frac{1}{100}$ part, the length in feet and parts to make 1 foot.

For 71.7 the Area of a Circle of 30 inches about, being multiplied by 24.1, produceth 1728, the cube-inches in a foot ſolid.

PROB. VII.

The Girt of any Cylinder given in inches, to find how many inches (or feet and inches is in one foot long.

The extent from 42.54 to the girt in inches, laid twice the ſame way from 12, gives the number of inches in one foot long.

Or the ſame extent laid twice from 1 the ſame way, gives the feet and parts in a foot long.

Examp. *At* 40 *inches about.*

The extent from 40 the inches about to 42.54, being laid twice the ſame way from 12, gives 13 inches and 63 parts, the content of one foot long.

Or the ſame extent laid twice the ſame way from 1, gives 1 foot, and 136 parts of 1000, the quantity in feet and parts in one foot long; which 136 parts is 1 inch, 6 tenths and a half, as is ſeen preſently by the inches and foot-meaſure laid together on your Two-foot Rule.

Then this 13 inches 63 parts multiplied by the length of the Tree, gives the true content.

PROB. VIII.

The Circumference or Girt given in inches, and the length in feet, to find the content of any Cylinder in feet and parts.

The extent from 42.54 to the inches about, being laid twice the ſame way from the length in feet, gives the content in ſolid feet required.

Examp. *At* 36 *inches about, and* 30 *foot long.*

The extent from 42.54 to 36 the inches girt, being laid twice the ſame way from 30 the feet long, gives 21 foot and a half, the near content in ſolid Feet.

For the Area of a Circle 36 inches about, is 133.1 inches; which multiplied by 30 the length of the Cylinder in feet, gives 3093; which ſumm divided by 144, produceth 21 foot 69 cube-inches, the near content.

PROB.

PROB. IX.

Having the Girt and length given in foot-meaſure, to find the content in feet.

The extent from 3.545 (the feet, and 100 parts about, when one foot long makes 1 foot of Timber) to the Girt in feet and parts.

The ſame extent laid twice from the length in feet, gives the content in feet.

Examp. *A Brewer's Tun of* 20 *foot about, and* 4 *foot and* ½ *deep, how many ſolid feet is it?*

The extent from 3.545 to 20, ſhall reach the ſame way at two turnings from 4 foot and ½ to 143 foot and 10 parts, the ſolid content in feet: and 6 foot being a full Beer-barrel, it contains 24 barrels, Beer-meaſure.

For 31 foot 8 parts, the Area of a Circle of 20 foot about, being multiplied by 4 foot 5 parts the depth, gives 143 foot and ten parts, as before.

PROB. X.

Having the Girt in inches, and the length of a Cylinder given in inches,

to find the ſolid content in cube-inches.

The extent from 3.545 to the Girt in inches, being twice repeated the ſame way from the length in inches, gives the content in inches.

Examp. *At* 48 *inches about, and* 24 *inches in length, how many cube-inches is it?*

The extent from 3.545 to 48 the inches girt, being twice repeated from 24 the length in inches, gives 4398 the content in ſolid inches.

For 183.2 the Area of a Circle of 48 inches about, multiplied by 24 the inches deep, produceth 4397 the near content as before.

To inſure you the number of places, the Print 11 times repeated, doth certainly direct you.

PROB. XI.

It being an ordinary way in Meaſuring of round Timber, ſuch as *Oak, Elm, Beech, Pear-tree*, and the like, (which is ſometimes very rugged, uneven, and knotty) to take a line and girt about the middle of it, and then to take the fourth part of that for the ſide of a Square-equal to that Circumference: but this meaſure is not exact, but more than it ſhould be. But either becauſe of allowance for the faults aboveſaid, or for ignorance, the cuſtom is ſtill uſed; and Men commonly think themſelves wrong'd, if they have not ſuch meaſure. Therefore I have fitted you with a Proportion for it, both for Diameter and Circumference.

And firſt for Diameter.

The Diameter given in inches, and the length in feet, to find the content.

As 1.526 to the diameter, ſo is the length to a fourth, and that fourth to the content in feet, according to the rate aboveſaid,

The extent from 1.526 to 9.53 being twice repeated from 8, ſhall reach to 3.12, the content.

PROB. XII.

Having the Circumference in inches, to find the content in the aboveſaid meaſure.

As 48 to the inches about, ſo is the length to a fourth number, and that fourth to the content. The extent from 48 to 30 being twice repeated from 8, ſhall fall upon 3. 12, the content required.

PROB. XIII.

How to meaſure Taper Timber, that is, bigger at one end than at the other.

The uſual way for doing of this, is to take the Circumference of the middle or mean bigneſs; but a more exact way, is, to find the content of the Baſe of both ends, and add them together; and then to take the half for the mean, which multiplied by the length, ſhall give you the true content.

Examp. A round Pillar is to be meaſured, whoſe diameter at one end is 20 inches, at the other end it is 32 inches diameter, and in length 16 foot (or 192 inches,) the content of the little end is 314.286, the Area or content of the greater end is 773. 142; which put together, make 1087. 428, whoſe half 543 714 multiplied by 192 the length, gives 104393. 143 cubical inches; which reduced into feet, is 60 feet and 713 cubical inches for the ſolid content of the Pillar.

PROB. XIV.

To meaſure a Cone, ſuch as is a Spire of a Steeple, or the like, by having the Height and Diameter of the Baſe.

Examp. Let a Cone be to be meaſured whoſe Baſe is 10 foot, and the height thereof 12 foot, the content of the Baſe will be found by the XIVth *Problem* of *Superficial Meaſure*, to be 78. 54: Then this 78. 54 multiplied by 4 a third part of 12, the perpendicular or height of the Cone will give 314. 4 for the content of the Cone required. By the Numbers work thus; The extent from 1 to 4 will reach from 78. 54 to 314. 4. But becauſe there may be ſome trouble in getting the true perpendicular of a Cone, which is its height, take this Rule: Firſt, take half the diameter, and multiply it in it ſelf, which here is 25; then meaſure the ſide of the Cone 13, and

multiply

multiply that by it ſelf, which is here 169, from which take the ſquare of half the Baſe, which is 25, your firſt number found, and the remain is 144, the Square-root of which is the height of the Cone, or length of the Perpendicular.

PROB. XV.

To meaſure a Globe or Sphere Arithmetically.

Cube the Diameter, then multiply that by 11, and divide by 21, gives you the true ſolid content. Let a Sphere be to be meaſured whoſe Axis or Diameter is 14; that multiplied by it ſelf, gives 196; and 196 again by 14, gives 2744; this multiplied by 11, gives 30184; and this laſt divided by 21, gives 1437.67 for the content of the Sphere whoſe Diameter is 14. But more briefly, by the Numbers thus; the extent from 1 to the Axis being twice repeated from 3.142, will reach to the ſuperficial content, that is, the ſuperficies round about. But if the ſame extent from 1 to the

Axis be thrice repeated from 5238, it will reach to the ſolid content; as 1 to 14, ſo 3.142 to 617 being twice repeated; as 1 to 14, ſo 5278 to 1437 being thrice repeated. As for many-ſided figures, if they have length, you have ſufficient for them in the Chapter of *Superficial Meaſure*, to find the Baſe; and then the Baſe multiplied by the Length, giveth the content. But as for figures of roundiſh form, they coming very ſeldom in uſe, I ſhall not in this place trouble you with them; for they may be reduced to Spheres, or Cones, or Triangles, or Cubes, and then meaſured by thoſe Problems accordingly. And ſo much for the Menſuration of *Solids*.

CHAP. VIII.

The Uſe of the Line of Numbers in Queſtions that concern Military Orders.

PROB. I.

Any number of Soldiers being propounded, to order them into a ſquare Battle of Men.

FInd by the XIIth *Problem* of the II^{d} *Chapter*, the Square-root of the Number given; for ſo much as that Root ſhall be, ſo many Soldiers ought you to place in Rank, and ſo many likewiſe in File, to make a ſquare Battle of Men.

Examp. Let it be required to order 625 Soldiers into a ſquare Battle of Men; the ſquare-root of that number is 25; wherefore you are to place 25 in Rank, and as many in File; for Fractions in this practice are not conſiderable: For had there been but 3 leſs, there would have been but 24 in Rank and File.

PROB.

PROB. II.

Any number of Soldiers being propounded, to order them into a Double Battle of Men; that is, which may have twice as many in Rank as File.

Find out the ſquare-root of half the number given, for that root is the number of Men to be placed in file, and twice as many to be placed in rank, to make up a double Battle of Men.

Examp. Let 1368 Soldiers be propounded to be put in that order: I find by the 12 aforeſaid, that 26, *&c.* is the ſquare-root of 684 (half the number propounded;) and therefore conclude, that 52 ought to be in rank, and 26 in file, to order ſo many Soldiers into a double Battle of Men.

PROB. III.

Any number of Soldiers being propounded, to order them into a Quadruple Battle of Men; that is, four times ſo many in Rank as File.

Here the Square-root of the fourth part of the number propounded will ſhew the number to be placed in File, and four times ſo many are to be placed in Rank.

So 2048 being divided by 4, the quotient is 512, whoſe root is 22 (6); and ſo many are to be placed in file, and 88 in rank, being 4 times 22, *&c.*

PROB. IV.

Any number of Soldiers being given, together with their diſtances in Rank and File, to order them into a Square Battle of Ground.

Extend the Compaſſes from the diſtance in File to the diſtance in Rank; this done, that extent applied the ſame way from the number of Soldiers propounded, will cauſe the moveable point to fall upon a fourth number, whoſe ſquare-root is the number of Men to be placed in File; by which, if you divide the whole number of Soldiers, the quotient will ſhew the number of Men to be placed in Rank.

Examp. 2500 Men are propounded to be ordered in a Square Battle of Ground, in ſuch ſort that their diſtance in File being 7 foot, and their diſtance in Rank 3 foot, the Ground whereupon which they ſtand may be a juſt ſquare. To reſolve this Queſtion, Extend the Compaſſes upon the Line of Numbers downwards from 7 to 3, (then becauſe the fourth number to be found, will in all likelihood conſiſt of four figures) if you apply that extent the ſame way from 2500 in the ſecond part among the ſmalleſt diviſions, the moveable point will fall upon the fourth number you look for, whoſe ſquare-root is the number of Men to be placed in File. By which ſquare-root, if you divide the whole number of Soldiers, you have the number of Men to be placed in Rank.

As 7 to 3, ſo 2500 to 1072, whoſe biggeſt ſquare-root is 32; then as 32 is to 1, ſo is 2500 to 78.

PROB. V.

Any number of Soldiers being propounded, to order them in Rank and File, according to the reaſon of any two numbers given.

This Problem is like the former; for as the proportional number given for the File, is to that given for the Rank, ſo is the number of Soldiers to a fourth number, whoſe ſquare-root is the number of Men to be placed in Rank; by which if you divide the whole, you may have the number to be placed in File.

Examp. So if 2500 Soldiers were to be martialled in ſuch order, that the number of Men to be placed in File, might bear ſuch proportion to the number of Men to be placed in Rank, as 5 bears to 12, I ſay then, as 5 is to 12, ſo is 2500 to 6000, whoſe ſquare-root is 77 the number in Rank; then as 77 is to 1, ſo is 2500 to 32, *&c.* the number of Men to be placed in File.

CHAP. IX.

The Uſe of the Line of Numbers, in Queſtions of Intereſt and Annuities.

PROB.

PROB. I.

A Summ of Money put out to Uſe, and the Intereſt forborn for a certain time, to know what it comes to at the end of that time, counting Intereſt upon Intereſt at any rate propounded.

Take the diſtance with your Compaſſes between 100, and the encreaſe of 100 *l.* for one Year, (which you muſt do very exactly) and repeat it ſo many times from the Principal as it is forborn Years, and the point of the Compaſſes will ſtay on the Principal with Intereſt, and encreaſe according to the rate propounded.

Examp. I deſire to know how much 125 *l.* being forborn 6 Years, will be encreaſed according to the rate of 6 *l. per Cent.* reckoning Intereſt upon Intereſt, or Compound Intereſt.

Extend the Compaſſes from 100 to 106; that extent being 6 times repeated from 125, ſhall reach to 177 *l.* the Principal encreaſed with the Intereſt at the term of 6 Years, at the rate propounded.

But if it were required for any number of Months; then firſt find what 100 is at one Month, and then ſay thus, If 100 gives 10 *s.* at 1 month, what ſhall 125 be at 6 months end? *facit* 75 *s.* And the work is thus:

Firſt ſay, If 100 gives 10 *s.* at one months end, what ſhall 125? and it makes 12 *s.* 6 *d.* Then ſay, If 1 month require 12 *s.* 6 *d.* what ſhall 6 months require? *facit* 75 *s.* that is 3 *l.* 15 *s.* the thing required to be found.

PROB. II.

A Summ of Money being due at any time to come, to know what it is worth in Ready Money.

This Queſtion is only the inverſe of the other; for if you take the ſpace between 106 and 100, and turn it back from the Summ propoſed as many times as there are years in the queſtion, it ſhall fall on the ſumm required.

Examp. Take the diſtance between 106 and 100, and repeat it 6 times from 177, and it will at laſt fall on 125, the ſumm ſought.

PROB.

PROB. III.

A Yearly Rent, Penſion, or Annuity being forborn for a certain term of Years, to find what the Arrears come to, at any rate propounded.

Firſt you muſt find the Principal that ſhall anſwer to that Annuity, then find to what Summ the Principal would be augmented at the rate and term of Years propounded; then if you ſubſtract the Principal out of that Summ, the Remainder is the Arrears required.

Examp. A Rent, or Annuity, or Penſion of 10 Pounds the Year, forborn for 15 Years, what will the Arrears thereof come to at the rate of 6 *per Cent.* Compound-Intereſt?

The way to find the Principal that doth anſwer to 10 *l.* is thus: If 6 *l.* hath 100 for his Principal, what ſhall 10 have? *facit* 166 *l.* 16 *s.* or 166 *l.* 8 *s.* For the extent from 6 to 10 will reach from 166. 8. which is 166 *l.* 16 *s.* Then, by the Firſt *Problem* of this *Chapter*, 166 *l.* 16 *s.* forborn 15 Years, will come to 398 *l.* Then ſubſtract 166 *l.* 16 *s.* out of 398 *l.* and the Remainder, *viz.* 231 *l.* 4 *s.* is the Summ of the Arrears required. But note, In working this Queſtion, by your often turning, unleſs your firſt extent be moſt preciſely exact, you may commit a groſs errour; to avoid which, divide your number of turns into 2, 3, or 4 parts, and when you have turn'd over one part, as here 5, for 3 times 5 is 15, open the Compaſſes from thence to the Principal, and then turn the other two turns, *viz.* 10--15, and this may avoid much errour, or at the leaſt, much mitigate it; for in theſe Queſtions, the larger the Line is, the better.

PROB. IV.

A Yearly Rent or Annuity being propounded, to find the worth in Ready Money.

Firſt, find by the laſt what the Arrears come to at the term propounded, and then what thoſe Arrears are worth in Ready Money, and that ſhall be the value of it in Ready Money.

Examp. What may a Leaſe of 10 *l. per Annum*, having 15 Years to come, be worth in Ready Money? I find by the laſt *Problem*, that the Arrears of 10 *l. per Annum* forborn 15 Years, is worth 231 *l.* 4 *s.* And likewiſe I find by the Second *Problem* that 231 *l.* 4 *s.* is worth in Ready Money 96 *l.* 16 *s.* and ſo much a Man may give for a Leaſe of 10 *l. per Annum* for 15 Years to come, at the rate of 6 *l. per Cent.*

But if it were not to begin preſently, but to ſtay a certain term longer, then you muſt add that time to the time of forbearance; as ſuppoſe that after 5 years it were to begin, then you muſt ſay, 231 *l.* 4 *s.* forborn 20 years, is worth in Ready Money 72 *l.* 8 *s.* and that ſhall be the Value of the Leaſe required.

PROB. V.

A Summ of Money being propounded, to find what Annuity to continue any number of Years, at any rate propounded, that Summ of Money will purchaſe.

Take any known Annuity, and

find the value of it in Ready Money; This being done, the proportion will be thus; as the Value found out is to the Annuity taken, ſo is the Summ propounded to the Annuity required.

Examp. What Annuity to continue 15 years will 800 *l.* purchaſe, after the rate of 6 *l. per Cent.*? Here firſt I take 10 *l. per ann.* for 15 years, and find it it to be worth in Ready Money 96 *l.* 16 *s.* by the laſt Problem; then I ſay, As 96 *l.* 8 *s.* is to 10, ſo is 800 to 82-7, which is 82 *l.* 14 *s.* and near ſo much do I conclude will an Annuity of 82 *l.* 14 *s. per ann.* be worth for 15 years, after the rate of 6 *l. per Cent.* viz. 800.

Alſo in this Impreſſion is added the Uſe of the *Line of Pence*, which is added to the *Line of Numbers* next to it, when it ſhall be deſired by any one, being very convenient for caſting up ſmall Summs of Money in any concern whatſoever.

The *Line of Numbers* and *Pence* together, do give the Decimal Fraction of any Summ under 20 *s.* very near, as by the Print to 11 Radixes is moſt plainly ſeen.

Where 20 *s.* or 1 *l.* in Money, is at 1 in the fourth line, and 2 *s.* one tenth of a pound, at 1 right over it in the third line; 9 farthings and 6 tenths of a farthing, being one tenth of two ſhillings, at 001 in the ſecond line right over 01.

Laſtly, $\frac{96}{100}$ parts of a farthing at 0001 in the firſt Line of Numbers towards the right hand, or the $\frac{96}{1000}$ parts, at the 00001 at the left end of the ſame Line.

Therefore note, If 20 *s.* is 1, 15 *s*, is 075, 12 *s.* is 06, 10 *s.* is 05, 5 *s.* is at 025, and 2 *s.* or 24 *d.* at 01, which on Two-foot Rules is ſet at 10 at the end of the Rule, though in this caſe called but one tenth, when 1 is one pound.

Then if 1 or 10 at the end, be 24 pence, 18 pence is at 75, 12 *d.* at 5, 6 *d.* at 25, 2 *d.* at 8. 33 in the firſt part, and 1 *d.* at 4166, and one farthing at 1042, a little beyond the firſt 1 on Two-foot Rules.

From hence you may ſee that the Print of the eleven *Lines of Numbers* ſheweth the right Decimal Fraction of any Summ under 1 *l. Sterl.* and by conſequence, for any Summ above, and was purpoſely made to explain this on Two-foot Rules.

The Uſe of the Line of Numbers and Pence laid together on Two-foot Rules, may be in a brief manner, thus;

1. At any price 100, or 5 ſcore, what coſt 1, counting 10 at the end of the Line 10 *l.*

Examp. At 5 *l. per* 100, counted at 5 in the ſecond part, becauſe 10 is call'd 10 *l.* juſt over or under it in the line of Pence, is 12 *d.* the exact anſwer, for 100 *s.* is 5 *l.*

2. *Examp.* At 2 *l.* 10 *s. per* 100, right againſt 2.5 on Numbers repreſenting 2 *l.* 10 *s.* right againſt it on the Line of Pence is 6 *d.* the Anſwer, for 100. 6 *d.* is 2 *l.* 10 *s.*

Now obſerve, If 1 in the middle is called 1 *l.* then in the firſt part, 9 is 18 *s.* 9.5 is 19 *s.* 5 towards the beginning-end is 10 *s.* and 1 at the very beginning-end is 2 *s.*

Then to ſupply all under 2 *s.* to 1 farthing, begin again at the upper-end at 10, where is ſet 24 *d.* the ſame with 2 *s.* and back again, 23. 22. 21. 20. 19. 18 pence at 75, then 17. 16. 15. 14. 13. 12 *d.* and 5, then 11. 10. 9. 8. 7. 6 *d.* at 25, then 5. 4. 3. 2 *d.* at 0. 834, then 1 penny at 0. 4166, then 3 farthings, 2 farthings, 1 farthing at 0. 1042, and every 10th of a *far.* in pricks between the *far.*

3. *Examp.* At 1 *l. per* 100, counted at the middle 1, is 2 *d.* 1 *far.* 6 tenths of a *far.* for 1.

4. *Examp.* At 10 *per* 100, counted at 5 in the firſt part, juſt againſt it in the Line of Pence, is 1 penny (or 4 farthings) and 8 tenths of a farthing, the true Anſwer.

5. *Examp.* at 2 *s. per* 100, counted at 1 at the beginning of the Line of Numbers, is no farthings, but 96 pts. of a farthing in 100 pts. the anſwer; for the half of 96 is 48, the farthings in 2 *s.*

6. *Examp.* But for any price under 2 *s. per* 100, count thus; As 12 *d.*

per 100, juſt againſt 12 *d.* on the Line of Pence, is 5 on numbers, for 5 tenths of a farthing, the near anſwer; for 5 tenths of a farthing is half a farthing, and 100 half farthings is 50 farthings, being 2 farthings above 48, the farthings in 1 ſhilling.

7. *Examp.* At 6 *d. per* 100, right againſt 6 in the Line of Pence, is 025, or one quarter of a tenth of a farthing on the Line of Numbers, the anſwer near the truth. For a hundred quarters of a farthing is 50 half farthings, or 25 farthings, one more than 6 *d.*

But if you count 1 farthing leſs for every 6 *d.* you ſhall have it right.

Examp. At 18 *d. per* 100, count 17 *d.* and 1 *far.* 3 *far.* leſs than 18 *d.* and juſt againſt it on Numbers, is $\frac{12}{100}$ parts of 1 farthing, the true price of 1.

Again, At 12 *d.* counted at 11 *d.* 2 *far.* juſt againſt it, on Numbers, is $\frac{48}{100}$ parts of a *far.* the price of 1.

Again, For 6 *d.* counted at 5 *d.* 3 *far.* juſt againſt it is $\frac{24}{100}$ parts of a far-a farthing, the true anſwer or price of 1.

I have been large in this, that you might ſee the reaſon of it the plainer.

Again, on the contrary upwards, at any price for 1, what coſt 100, or 5 ſcore.

At $\frac{48}{100}$ pts. of a farthing for 1, the price of 100, is juſt 12 *d.* the contrary to the laſt Example but one.

Again, At $\frac{72}{100}$ pts. of a farthing for one, 100 will coſt juſt 18 *d.* as in the laſt Examp. but two foregoing.

Again at $\frac{69}{100}$ pts. of a farthing for 1, 100 is juſt 2 *s.* Note, The 96 is juſt againſt 23 *d.* being 4 *far.* leſs than 2 *s.* that is, four farthings abated for the 4 Sixpence's in 2 *s.*

But for all ſumms between 2 *s.* at 1 at the beginning-end, and 10 *l.* at the end of the Line. This in Three Examples.

1 *Examp.* At 4 *s. per* 100 counted at 2 in the firſt part of the Line of Numbers, juſt againſt it on the Line of Pence, is 1 farthing and $\frac{92}{100}$ more for 1.

2 *Examp.* At 13 *s. per* 100, counted at 6.5 on the Line of Numbers, juſt againſt it on the Line of Pence, is 6 farthings, two tenths and $\frac{1}{2}$, the anſwer.

3 *Examp.* At 3 *l. per* 100, counted at 3 in the ſecond part, is 7 *d.* 0 *far.* $\frac{8}{10}$ of a farthing, the anſwer.

But if your 100 be 5 ſcore and 12, then count thus with a pair of Compaſſes. The extent from 112 to 3 *l.* counted as before, laid the ſame way from the middle 1, gives 6 *d.* 1 *far.* $\frac{8}{10}$ of a farthing more for 1 *l.*

Again, on the contrary, If 1 coſt 7 *d.* farthing, and half a farthing, what coſt 112?

The extent from the middle 1 to 7 *d.* 1 *far.* and half a *far.* (half way beyond the prick) being laid the ſame way from 112, will reach to 3.45, or 3 *l.* 9 *s.* the anſwer. For if every figure in the ſecond part be 1 *l.* then every 10th cut between is 2 *s.* then 4 $\frac{1}{2}$ and 45 is 9 *s.*

Alſo, if every figure in the firſt part is 2 *s.* then 5 cuts or tenths beyond any figure is 12 *d.* 2½ is 6 *d.* 1 is 2 *d. far.* ½ *far.*

Juſt as you ſee by counting 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. in the ſecond part on the Numbers, juſt againſt it on the Pence, is the exact reduction to pence and farthings required.

Examp. Againſt 3 is 7 *d.* near a farthing, againſt 6 is 14 *d.* near 2 farthings, againſt 7. 5 is juſt 18 *d.* And ſo for all other.

Again, when the price of 100 coſts above 10 *l.* then count thus:

Examp. At 65 *l.* 15 *s.* and 6 *d. per* 100.

Firſt, 65 doubled is 13 *s.* then the 15 *s.* 6 *d.* counted on the firſt part of the Line of Numbers at 7. 75, and juſt againſt it on the Line of Pence is 7 *far.* and 44 pts. the true anſwer is 65 *l.* 15 *s.* 1 *d.* 3 *far.* and 44. 100 pts. of 1 farthing.

Again, At 18 *s.* 7 *d.* 2 *far.* for 1, what is the price of 100?

Note, 18 *s.* is at 9 on the firſt part of the Numbers, which here ſtands for 90 *l.* then ſeek the odd 7. *d.* 2. *far.*

on the Line of Pence, and juſt againſt it on the Line of Numbers is 3.125, the 3 is 3 *l.* the 1 more is 2 *s.* and the 25 more is 6 *d.* in all 93 *l.* 2 *s.* 6 *d.* the price of 100.

For 1800 *s.* is 90 *l.* 100 times 7 *d.* is 2 *l.* 18 *s.* 4 *d.* 100 half-pence is 4 *s.* 2 *d.* in all 93 *l.* 2 *s.* 6 *d.*

Once more, for a greater Summ, at 8 *l.* 5 *s.* 6 *d.* for 1, what coſts 100?

Firſt, to 8 *l.* add two Cyphers, and it is 800 *l.* then add two Cyphers to the 5 *s.* and it is 500 *s.* or 25 *l.* then juſt againſt 6 *d.* in the Line of Pence, in the Line of Numbers, is 2 *l.* 10 *s.*

In all 827 *l.* 10 *s.* the true price of 100 at 8 *l.* 5 *s.* and 6 *d.* for 1.

A further Uſe of the Lines of Pence and Numbers in ſeveral Queſtions.

1. If 2 *l.* and $\frac{1}{2}$ of any Commodity coſt 7 *d.* 3 *f.* and $\frac{1}{4}$ of a *far.* what coſt 32 *l.* $\frac{3}{4}$?

The extent from 2.5. on Numbers to 7 *d.* 3 *f.* and $\frac{3}{4}$ on the Line of Pence, being laid the ſame way from 3275, ſhall reach to 4.27.

Note, The 4 is 8 *s.* and the 27 more counted on the Line of Numbers beyond the middle 1, gives on the Line of Pence near 6 *d.* 2 *f.* in all 8 *s.* 6 *d.* 2 *f.* the true anſwer.

If 3 yards and a half of Ribbon coſt 3 *d.* 3 *f.* and ½, what will 17 yards and ½ coſt? The extent from 3.5 on the Line of Numbers to 3 *d.* 3 *f.* and *half far.* on the Line of Pence, being laid the ſame way from 17.5 on the Line of Numbers, reaches to 19 *d.* 1 *f.* and half on the Line of Pence, the true Anſwer.

3. If 1 yard of Plaiſtering coſt 8 *d. half-pen.* what will 142 yards and a half coſt? The extent from 1 on the Line of Numbers to 8 *d. half-pen.* on the Line of Pence, laid the ſame way from 142 ½ on Numbers, reaches to 5.047; the 5 is 5 *l.* and the 047 more, counted on Numbers, on the Pence, is 11 *d.* 1 *f.* the true Anſwer.

4. If 112 *l.* coſt 2 *l.* 10 *s.* 6 *d.* what will 21 *C.* 3 *q.* and 12 *lb* coſt?

The extent from 112 to 2.525,

for 2 *l.* 10 *s.* 6 *d.* laid the ſame way from 2448, the pounds in 21 *C.* 3 *q.* and 12 *lb.* ſhall reach to 55 *l.* 4 *s.* the near true Anſwer.

For if 2.525 the decimal for 2 *l.* 10 *s.* 6 *d.* be multiplied by 2448, the pounds in 21 *C.* 3 *q.* 12 *lb.* the product is 6181200; which divided by 112, the quotient is 55 *lb.* 189; which reduced, is near 4 *s.* or 3 *s.* 38 *f.* or 9 *d.* *half-penny.*

5. If 5 ounces and a half of *Nutmegs* coſt 20 *d.* 3 *f.* what ſhall 1 *C.* 1 *q.* 15 *lb.* come to?

The extent from 5 ½ on Numbers to 20 *d.* 3 *f.* on the Line of Pence, ſhall reach from 16 the ounces in 1 *lb.* to 02518, the 25 is 5 *s.* and the 18 more is 1 *f.* 7 tenths, the price of 1 *lb.*

Then the extent from 1 on Numbers to 2518, laid the ſame way from 155, the pounds in 1 *C.* 1 *q.* and 15 *lb.* ſhall reach to 39 *l.* 0 *s.* 10 *d.* the near true Anſwer to the Queſtion.

CHAP.

CHAP. X.

The application of the Line of Numbers to uſe in Domeſtick Affairs, as in Coals, Cheeſe, Butter, and the like.

I Have added this Chapter, not that I think it abſolutely neceſſary, but only becauſe I would have the abſolute applicableneſs of the Rule to any thing hinted at; for it may be the Anſwer of ſome, *Do you come with a Rule, to meaſure my Commodities which are ſold by Weight?* Yea, ſo far as there is proportion, it concerns that and any thing elſe, the Application of which I leave to the induſtrious Practitioner: only I here give him a hint; as much as to ſay, here is a Treaſure, if you dig, you may find; for ſome may be apt to think, it being a *Carpenter's-Rule*, it is fit but for *Carpenters* Uſe only. But know, that in all Meaſures which are either Lengths, Superficials or Solids, or as ſome call it, *Longametry*, *Planametry*, and *Solidametry* : and in all Liquids by Weight or Meaſure: and in all Time, either by Years, Months, Weeks, Days, Hours, Minutes, and Seconds, and almoſt (I think I may ſay) in all things Number is uſed, and in many things Proportional Numbers: Why then may not this Line put in for a Share of Uſe, ſeeing it is wholly compoſed of, and fitted for Proportional Numbers, and of ſo eaſie an attainment for any ordinary Capacity, and chiefly intended for them that be ignorant of *Arithmetick*, and have not Time to learn that Noble Science as ſome have.

And firſt, for more conveniency of Reduction, take theſe following Rules.

Rules for Engliſh Money.

Note, that 4 farthings make a penny; 16 farthings, 8 half-pence, or 4 pence, make a groat; 48 farthings, 24 half-pence, or 12 pence, make a ſhilling; 40 pence, or 10 groats, is 3 ſhillings 4 pence; 80

pence, 20 groats, or 6 ſhillings 8 pence, is a noble; 160 pence, 40 groats, or 13 ſhillings 4 pence, is a mark; 20 ſhillings, 4 crowns, 3 nobles, or 2 angels, is a pound ſterling.

Rules for Troy *Weight.*

Note, that 24 grains is a penny-weight; 20 penny-weights, or 24 carrots, is an ounce Troy; 12 ounces is a pound; 25 lib. is a quarter of a hundred, 50 lib. half a hundred, 75 lib. three quarters of a hundred, and 100 lib. is an hundred weight *Troy*.

Rules for Averdupois *Weight.*

Note, that 20 grains make a ſcruple; 3 ſcruples is a drachm; 8 drachms is an ounce; 16 ounces is a pound; 8 lb. a ſtone; 28 lb. a quarter of a hundred; 56 lb. half a C. 84 lb. 3 quarters of a C. and 112 lb. or 14 ſtone, or 4 quarters of a C. is an hundred weight; 5 C. is a hogſhead weight; 19 C. and ½ is a Fother of Lead; and 20 C. is a

Tun weight. And note, that *l.* ſignifies a Pound in Money, and lb. ſignifies a Pound in Weight either *Troy* or *Averdupois.*

Rules for Concave Dry Meaſure.

Note, that 2 pints is a quart, 2 quarts a pottle, or quarter of a peck; 8 pints 4 quarts; 2 pottles is one gallon, or half a peck; 2 gallons is a peck; 2 pecks make half a buſhel; 4 pecks or 56 lb. make a buſhel; 2 buſhels is a ſtrike; 2 ſtrikes a coomb, or half-quarter; 2 coombs, 4 ſtrikes, or 8 buſhels, make a Quarter, or a Seame; 10 Quarters, or 80 buſhels, make a Laſt.

Rules for Concave Wet Meaſure.

Note, that 2 pints is a quart; 2 quarts a pottle; 2 pottles, 4 quarts, or 8 pints, make a gallon; 9 gallons make a firkin, or half a kilderkin; 18 gallons make 2 firkins, a kilderkin, or a rundlet; 36 gallons is 2 kilderkins, or a barrel; 42 gallons make a terce; 63 gallons,

lons, or 3 ½ Rundlets make a Hogſhead; 84 gallons, or 2 Terces, make a Tercion or Punchion; 126 Gallons is 3 Terces, 2 Hogſheads, 1 Pipe, or a But: A Tun is 252 Gallons, 14 Rundlets, 7 Barrels, 6 Terces, 4 Hogſheads, 3 Punchions,, 2 Pipes, or Buts. Note, That in Sweet-Oil, 236 Gallons make a Tun; but of Whale-Oil 252 go to the Tun.

Water Meaſure.

Note, that 5 pecks is a buſhel; 3 buſhels a ſack, 4 ½ buſhels a flat; 12 ſacks, 4 flats, or 36 buſhels, make a Chaldron of Coals.

Rules for Long Meaſure.

Note, that 3 barley-corns make an inch; 2 ¼ inches make a nail; 4 nails, or 9 inches, make a quarter of a yard; 12 inches make a foot; 3 foot, 4 quar. 16 nails, or 36 inches, make a yard; 45 inches, or 5 quar. of a yard, make an Ell; 5 foot is a pace; 6 feet, or 2 yards is a fathom; 5 yards and an half, or 16 feet and an half, is a Pole, Rod, or Perch; and 160 perches in length,

length and 1 in breadth, or 80 perches in length and 2 in breadth, or 4 in breadth and 40 in length, make an Acre.

220 yards, or 40 poles, is a furlong; 1760 yards, 320 poles, or 8 furlongs, is an *Engliſh* Mile; 3 Miles is a League; 20 Leagues, or 60 Miles, is a Degree in ordinary account, and every Mile a Minute.

Rules for Motion and Time in Aſtronomy and Navigation.

Note, that a Minute contains 60 Seconds, and 60 Minutes is 1 Degree; and 30 Degrees is 1 Sign; 2 Signs, or 60 Degrees is a Sextile ✱; 3 Signs, or 90 Degrees, is a Quadrant or Quartile □; 4 Signs, or 120 Degrees, a Trine △; 6 Signs, or 180 Degrees, is an Oppoſition ☍, or Semi-circle; 12 Signs, or 360 Degrees, is a Conjunction ☌, and the Sun's Annual or Moon's Monthly Motion. Note alſo, every Hour of Time hath in Motion 15 Degrees; and a Minute of Time hath 15 Minutes of Motion; and 1 Degree of Motion is 4 Minutes of Time.

Note further, that every Hour of Time hath 60 Minutes, therefore 45 is 3 quarters, 30 is half, 15 is a quarter of an Hour; 24 Hours a Day Natural, 7 Days a Week, 365 Days, and about 6 Hours is a Year. Hence it follows, that a $\frac{1}{4}$ of a Degree in the Heavens is 5 Leagues on the Earth; or 15 Minutes of Motion above, is one Minute of Time below; therefore a Degree, or 60 Minutes of Motion, is 4 Minutes of Time, as before is ſaid.

All theſe Rules I ſhall expreſs more largely, and in ſhorter terms, by theſe following Tables.

Equation for Motion.

	Signs.	*Deg.*	*Min.*	*Seconds.*
Note, that the Twelve Signs is	12	360	21600	1296000
One Sign is	1	30	1800	108000
One Deg. is		1	60	3600
One Min. is			1	60

Equation for Time.

	Mon.	*Week.*	*Day.*	*Hour.*	*Min.*
One Year	13	52	365	8760	525600
Month hath	1	4	28	671	40320
Week hath		1	7	168	10080
Day Natural			1	24	1440
Hour hath				1	60
Minute is					1

Equation for Long Meaſure.

	Mile.	*Furl.*	*Perch.*	*Yards.*	*Feet.*	*Inches.*
Leag.	3	24	960	5280	15840	190080
Mile		1	8	320	1760	5280	63360
Furlong		1	40	220	660	7920
Per. Rod. Pol.			1	5½	16½	198
Acre contains of Square P.			160	4840	43560	
Acre is in leng.		1	40	220	660	7020
Acre is in breadth			4	22	66	792
1 Rood, or ¼ of an Acre, is in -- leng.			40			
1 Rood, or ¼ of an Acre, is in -- bread.			1	5½	16½	198
One Fathom is					6	72

One

One Ell Engliſh *is*	3¼	45
One Yard is	3	36
One Foot is	1	12
One Inch is 1 *Inch*, 3 *Grains*		1

Equation of Liquid Meaſure.

	Gal.	*Pottl.*	*Quarts.*	*Pints.*
Tun of Sweet-Oil is	236	472	944	1888
Tun of Wine is	252	504	1008	2016
But or Pipe is	126	252	504	1008
Tertion of Wine	84	168	336	672
Hogſhead is	63	126	252	504
A Barrel of Beer, or 2 *Rundlets of Wine, is*	36	72	144	288
Kilderkin, or 1 *Rundlet, is*	18	36	72	144
Barrel of Ale is	32	64	128	256
Kilderkin of Ale is	16	32	64	128
Firkin of Beer is	9	18	36	72
Firkin of Ale is	8	16	32	64

Equation of ſmall Dry Meaſure, and then of great Meaſure.

	Peck.	*Gal.*	*Pottl*	*Qu.*	*Pi.*
Buſhel of Water-meaſ. is	5	10	20	40	80
Buſhel of Land-meaſ. is	4	8	16	32	64
One Peck is		1	2	4	8	16
One Gallon is			1	2	4	8
One Pottle is				1	2	4
One Quart is					1	2

	Laſt.	*Weig.*	*Chal.*	*Qu.*	*Buſh.*	*Peck.*	*Pint.*
Laſt of Dry-meaſ.	1	2	2½	10	80	320	5120
One Weight is		1	1¼	5	40	160	2560
Chaldron of Coals is			1	4	36	144	2098
Quarter of Wheat is				1	8	32	512
One Buſhel is					1	4	62

Equation for Averdupois *Weight.*

	Hogſh.	*C.*	*Ston.*	*Lib.*	*Ounces.*	*Drams.*	*Scruples.*	*Grains.*
Tun-weight Groſs is	4	20	280	2240	35840	286720	860160	17203200
One Hogſhead is		1	5	70	560	8900	71680	215040	4300800
One C. *or Hundred, is*			1	14	112	1792	14336	43008	860160
One Half C. *is*				7	56	876	7168	21504	430080
One Quarter of C. *is*				$3\frac{1}{2}$	28	448	4584	10752	213040
One Stone is			1	8	128	1024	3072	61440
One Lib. *or Pound, is*				1	16	128	384	7680
One Ounce is					1	8	24	480
One Drachm is						1	3	9
One Scruple is							1	3

Equation for Troy *Weight.*

	Lib.	*Ounce.*	*Dp.*	*Carrots.*	*Grains.*
C.w.	100	1200	24000	28800	576000
$\frac{1}{2}$*C. is*	50	600	12000	14400	288000
$\frac{1}{4}$*C. is*	25	300	6000	7200	144000
$\frac{1}{8}$*C. is*	$12\frac{1}{2}$	150	3000	3600	72000
Pound	1	12	340	288	5760
Ounce		1	20	24	480
One Penny-weight is			1	$1\frac{1}{5}$	24
One Carrot Troy *is*				1	20
One Grain is					1

Equation of Money.

	Mark.	*An.*	*Nob.*	*Cro.*	*Sh.*	*Groat.*	*Penc.*	*Far.*
Pound ſt.	$1\frac{1}{2}$	2	3	4	20	60	240	960
Mark is	1	$1\frac{1}{3}$	2	$2\frac{2}{3}$	$13\frac{1}{3}$	40	160	640
An Angel is		1	$1\frac{1}{2}$	2	10	30	120	410
A Noble is			1	$1\frac{1}{3}$	$6\frac{2}{3}$	20	80	320
A Crown is				1	5	15	60	240
A Shilling is					1	3	12	48
A Groat is						1	4	16
A Penny is							1	4

The Uſe of which (to come to our intended purpoſe) may be thus. There you ſee how many Farthings, Pence, Groats, Shillings, and the like, is in one, or any uſual Piece of Coin; alſo, how many Ounces, Scruples, in any kind of Weight; and the like for Meaſure, both Liquid and Dry; and alſo in Time. Now if you would know how many there ſhall be in any greater number than one; then ſay, by the *Rule* (or *Line of Numbers*) thus; If 48 Farthings be 1 Shilling, how many Shillings is 144 Farthings? *facit* 3 *s.* for the extent from 48 to 1, will reach from 144 to 3, and the contrary.

Again, *If a Mark and a half be* 1 *Pound, how many Pound is* 12 *Marks?* The extent from 1.50 to 1, ſhall reach from 12 to 8; for Reaſon muſt help you not to call it 80 *l.* Again, *If* 3 *Nobles be* 1 *l. what is* 312 *Nobles? facit* 104 *l.* the extent from 3 to 1 will reach from 312 to 104.

Further, *If a Chaldron of Coals coſt* 36. *what ſhall half a Chaldron coſt? facit* 18. But more to the matter; *If*

36 *buſhels coſt* 30 s. *what ſhall* 5 *buſhels coſt?* *facit* 4. 16. that is, by Reduction, 4 *s.* 2 *d.* near the matter, or penny, or 3 farthings half-farthing, and better: Or, on the contrary, *If* 1 *buſhel coſt* 8 *d.* *then what coſt* 36? *facit* 288 *d.* which being brought to ſhillings, is juſt 24; which you may do thus; *If* 12 d. *be* 1 s. *how many ſhall* 288 *be?* facit 24. for the extent from 12 to 1 ſhall reach the ſame way from 288 to 24, as before. The like may be applied to all the reſt of the Rules of Weight and Meaſure; of which take, in fine, ſome Examples in ſhort, and their Anſwers.

If 14 *Stone be* 1 C. *what is* 91 *Stone?* facit 6 C. *and a half.*

If 1 *Ounce be* 8 *Drachms*, *how many Drachms in* 9 *Ounces?* facit 72. The extent from 1 to 8, reacheth from 9 to 72.

If 1 buſhel of Water-meaſure be 5 pecks, how many pecks is 16 buſhels? *facit* 80 pecks.

If 1 barrel hold 288 pints, how much will a firkin hold? This being the fourth part of a barrel, work thus, if 1 give 288, what 25? *facit* 72, the Anſwer ſought.

If 1 week be 7 days, how many days is 39 weeks? As 1 is to 7, ſo is 39 to 273. ſo many days in 39 weeks.

If 160 perches be 1 acre, how many acres is 395 perches? *facit* 2.492, that is, near 2 acres and an half.

If 8 furlongs make 1 mile, how much is 60 furlongs? *facit* 7 miles and an half; for the extent from 1 to 8, gives from 60 to 7.50.

CHAP. XI.

To meaſure any Superficies or Solid by Inches only, (or by Foot-meaſure) without the help of the Line, by multiplication of the two ſides.

PROB. I.

POſſibly that this little Book may meet with ſome that are well skill'd in Arithmetick, and being much uſed to that way, are loth to be weaned from that way, being ſo artificial and exact; yet though they can Multiply and Divide very well, yet perhaps they know not this way to ſave their Diviſion, and yet to take in all the

Fractions together, as if of one Denomination: I ſhall begin firſt with *Foot-meaſure*, being the more eaſie, and I ſuppoſe my Two-foot Rule to be divided into 200 parts, and figured with 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. and then ſo again to 200, as in the 3d *Chapter*, and then the work is only thus: Set down the meaſure of one ſide of the ſquare or oblong thus, as for Example, 7.25. and 9 88, and multiply them as if they were Whole Numbers, and from the product cut off four figures, and you have the content in Feet, and 1000 parts of a Foot, or Yard, Ell, Perch, or whatſoever elſe it be. Note the Examples following.

```
   7 25
   9 88
 ------
  58 00
 580 0
 6525
 ------
 71|6300
 -------
```

```
   12 29
   19 72
  ------
   24 58
  860 3
 11061
 1229
 --------
 242|3588
 --------
```

For any kind of Flat Superficies, this is ſufficient Inſtruction to him that hath read the Firſt Part: But if it be Timber or Stone, you muſt thus find the Baſe, and then another work will give you the other ſide, as in *Chap.* V. *Prob.* II. or multiply the length by the product of the breadth and thickneſs, and that product ſhall be the content required.

PROB. II.

To multiply Feet, Inches, and 8 *parts of an Inch together, without Reduction, and ſo to meaſure Superficial (and Solid) Meaſure.*

Firſt, multiply all the whole feet, then all the feet and inches a-croſs, and right on, then the parts by the feet, and alſo the inches and parts a-croſs and right on; then add them together, and you ſhall have the Anſwer in feet, long inches, (that is, in pieces of a foot long, and an inch broad) ſquare inches, and 8 parts of a ſquare-inch. As for *Example:*

Let a piece of Board be given to be meaſured that is 3.3.5. *i. e.* 3 foot, 3

3 inches, and 5 eights one way, and 2. 3. 4. the other way, I ſet the numbers down in this manner, and then right on, firſt as the line in the Scheme from 2 to 3 leads.

3. 3. 5.
2. 3. 4.

I ſay thus, 3 times 2 is 6, ſet 6 right under 2 and 3, as in the Example in the left page: for 6 foot, as is clear, if you conſider the Scheme over the Example, *viz.* the ſquares noted with *f*. Then for the next, I ſay croſs-wiſe, 2 times 3 is 6, *viz.* long inches, as you may perceive by the two long ſquares marked with 9 L. and 6 L. which 6 I put in the next place to the right-hand, as in the Example: Then for the next, *viz.* 3 times 3 is 9 (croſs-wiſe, as the ſtroke from 3 to 3 ſhews) which 9 is alſo 9 long-inches, as the Scheme ſheweth, and muſt be put under 6 in the ſecond place towards the right-hand; in the Scheme it is expreſſed by the three long ſquares marked with L 9. Then, laſtly, for the inches, 3 times 3 is 9, going right up, as the ſtroke from two 3's lead you: But

Note, this 9 muſt be ſet in the next place to the right-hand, becauſe they are but 9 ſquare inches; but had the product been above 12, you muſt have ſubſtracted 12 out, and ſet them in the long-inches place, and the Remainder, where this 9 now ſtandeth, and this 9 is expreſſed in the Scheme, by the little ſquare in the corner mark'd with (☐ 9.)

Then now for the Fractions, or 8 parts of an inch, firſt ſay, croſs-wiſe, as the longeſt prick-line doth lead you to, 3 times 4 is 12, for which 12 you muſt ſet down 1.6, that is, 1 long-inch, and 6 ſquare-inches; the reaſon is, a piece 8 half quarters of an inch broad, and 12 inches long, is a long-inch, or the twelfth part of a foot ſuperficial; and if 8 be 12 ſquare-inches, then 4 muſt needs be 6 ſquare-inches: therefore inſtead of 12, I ſet down 1.6, as you may ſee in the Example, and in the leaſt long ſquare of the Diagram or Scheme. Then do likewiſe for the other long ſquare, which is alſo multiplied a-croſs, as

2 times 5 is 10; that is, as I ſaid before, 1.3, as the Example and Scheme make manifeſt, conſidering what I laſt ſaid, and it is marked by the 2.00. But if this or the other had come to a greater number, you muſt have ſubſtracted 8 as often as you could, and ſet down the remainder in the place of ſquare-inches, and the number of 8 in the place of long-inches, as here you ſee.

Then for the two ſhorter long-ſquares next the corner, ſay croſs-wiſe again, 3 times 5 is 15, that is, 1.7; becauſe 8 half-quarters an inch long, do make one ſquare-inch, as well as 8 half-quarters a foot long made 1 long-inch; therefore I ſet 1 in the place of ſquare-inches, and 7 in the next place to the right-hand, and it is expreſſed in the Diagram by the ſmall long-ſquare, and marked with * 1.7.

Then again for the other little long-ſquare, ſay croſs-wiſe, as the ſhorter prick-line leads you, 3 times 4 is 12, that is 1.4; and do by this, as the laſt: it is noted in the Scheme by 1.4.

Then laſtly, for 5 times 4, as the ſhort prick-line ſheweth you, is 20: out of which 20 take the 8 *s.* and ſet them down in the laſt place, and the 4 remaining you may either neglect (or ſet it down a place farther) for you cannot ſee it on the Rule; therefore I thus adviſe, If it be under 4, neglect it quite; but if above, encreaſe the next a figure more; if 4, then it is an half, and ſo may be added; for Note, 64 of theſe parts make but 1 ſquare-inch, of which parts the little ſquare in the right-hand lower corner of the Scheme is 20, for which I ſet down 2. 4, that is, two half-quarters and 4 of 64, which is the laſt work, as you may ſee by the Scheme and Example.

Now to add them together, ſay thus; 4 is 4, which I put fartheſt to the right-hand, as it were uſeleſs, becauſe not to be expreſs'd; then 472 are 13, from which take 8, and for it carry 1 on to the next place, or as many times 1 as you find 8, and ſet down the remainder, which here s 5;

then 1 I carried, and 13619 is 21, from which I take 12, and ſet down 9, becauſe 12 ſquare-inches is 1 long-inch; then 1 I carried, (or more, had there been more, 12 *s.*) and 1169, is 18; from which take 12, as before, there remains 6, that is, 6 long-inches; and ſo had there been more 12. ſo many you muſt carry to the next place, becauſe 12 long-inches is 1 foot; laſtly, 1 I carried and 6 is 7 foot: ſo that the work ſtands thus,

F. Lo. Inc. Sq. Inc. 8. 64.
7——6——9——5——4

And ſo for any other Meaſure, Superficial or Solid.

To multiply Feet, Inches, and 12 *Parts of an Inch, by Feet, Inches, and* 12 *Parts of an inch.*

Altho' the uſual way of dividing the line of inches, on ordinary Two-foot Rules, is into 8 parts, according to which counting the former Rule is worded, into feet, inches, and 8 parts of an inch.

Yet if every inch be divided into 12 parts, or conceived ſo to be, which you may eaſily count by calling every quarter of an inch 3, every half inch 6, every three-quarters 9.

Then the parts between 3, 6, and 9 may be eaſily eſtimated by help of the half-quarter cut.

Then I ſay, the Arithmetical Multiplication will be much eaſier, being brought to one denomination after the way by Decimals, and ſomewhat more exact, as will appear by this following Example.

Suppoſe a Cedar-board be 2 foot 3 inches, and 7 twelve parts of an inch broad, and 9 foot 5 inches and 8 twelve parts of an inch long, how many ſuperficial feet is it?

Firſt, ſet down the numbers as is uſually done in their three denominations of feet, inches, and 12 parts, as in the Example is made apparent by the black lines and the prick'd lines down-right and ſloping from figure to figure, done ſo only for eaſe and plainneſs, in wording of it to a Learner.

Then proceed in the Multiplication thus;

1. *Firſt*, 2 times 9 is 18, as the down-right black line from 2 to 9 ſheweth, for which ſet down 18 foot under the 2 and 9, as in the Example.

2. *Secondly*, Say 9 times 3 is 27 long-inches, as the ſloping black line from 9 to 3 ſheweth; for which 27 you muſt ſet down 2 foot in the place of feet, and 3 in the place of long-inches, becauſe 27 long-inches is 2 foot 3 inches.

3. *Thirdly*, Say 2 times 5 is 10 long-inches, as the ſloping black line from 2 to 5 ſheweth, for which you ſet down only 10 long-inches under 5 and 3, as in the Example, becauſe it is under 12 long-inches, which make 1 foot, as in the Second juſt before.

4. *Fourthly*, Say 3 times 5 is 15 ſquare-inches, as the ſhort black line from 3 to 5 ſheweth, every 12 whereof makes 1 long inch. Therefore I ſet down 1 long-inch in the place of long-inches, and the 3 ſquare-inches over in the place of ſquare-inches right under 7 and 8.

5. *Fifthly*, Say 9 times 7 is 63 ſquare-inches, as the long prick'd-line from 9 to 7 ſheweth, every 12 whereof makes 1 long inch, and every 144 one foot; therefore I ſet down 5 long-inches in that place, and 3 in the place of ſquare-inches.

6. *Sixthly*, Say 2 times 8 is 16 ſquare-inches, as the other long ſloping prick'd-line from 2 to 8 ſheweth, for which ſet down one long-inch, and 4 ſquare-inches, each in their proper places, as in the Fifth laſt-mention'd.

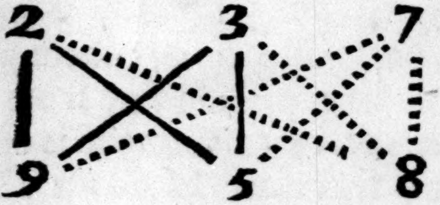
7. *Seventhly*, Say 5 times 7 is 35, 144 or 12 parts of 1 ſquare-inch, as the ſhorter ſloping prick'd line from 5 to 7 ſheweth, every 12 whereof is one ſquare-inch; therefore ſet down 2 in the place of ſquare-inches under 7 and 8 and 11, the parts over in a ſpace beyond, under 144.

8. *Eightbly*, Say 3 times 8 is 24, 144 or 12 parts of one ſquare-inch, as before, as the other ſhort ſloping prick'd-line ſheweth, every 12 whereof is 1 ſquare-inch; therefore I ſet

down 2 in the place of ſquare-inches under 8 and 7, and no more, becauſe nothing is over 2 halves.

Laſtly, Say 7 times 8 is 56, 1728 *s.* as the ſhort down-right prick'd line from 7 to 8 ſheweth, every 12 whereof makes 144, or the 12th part of 1 ſquare-inch; therefore I ſet down 4 in the place of 144, and the 8 parts over in the place of 1728 *s.* being a place further, as in the Example you ſee done.

Feet.	*Lon. Inc.*	*Sq. Inc.*	144.	1728.



18	3	3	11	8
2	10	3	4	
	1	4		
	5	2		
	1	2		
21 —	9 —	3 —	3 —	8

1. Then add them together, ſaying, 8 under 1728 is 8, and no more.

2. Then 11 and 4 is 15; ſet down 3 under 144, and carry 1 to the next place.

3. One I carry'd and 2. 2. 4. 3. 3. under the ſquare-inches, or 12. is 15, for which I ſet down 3, and carry 1 to the next place.

4. One I carry'd and 1. 5. 1. 10. 3. is 21, for which I ſet down 9 under the long-inches, and carry 1 to the next place.

5. One I carry'd and 2 and 8 is 11, for which I ſet down 1 and carry 1 to the next place.

6. One I carry'd and 1 is 2, in all 21 foot 9 long-inches, or 12 parts of a foot; 3 ſquare-inches, or 12 parts of a long-inch; 3. 144 or 12 parts of a ſquare-inch, and 8. 1728 parts of a long-inch.

If it be a piece of Timber or Stone, then having thus gotten the Area of the Baſe, then multiply that Area by the length in feet, inches, and 12 parts, and the product ſhall be the ſolid content required.

As in this Example, 1. 2. 4 *thick*, 2. 1. 6 *broad*, *and* 9 *foot* 7 *inches* 6 *twelves long*.

1	2	4		2	6	5	6		
2	1	6		9	7	6	0		
2	4	2	4	18	6	6	11		
	1	8	2	4	2	9	2	6	
		6		1	3	2	4	3	6
		1			3	3			3
					1				
2	6	5	6	24	4	9	5	9	9

The

The USE of the
Line of Numbers
ON A
SLIDING (or *GLASIER's*)
RULE,

In *Arithmetick* and *Geometry*.

AS ALSO

A moſt Excellent Contrivance of the *Line of Numbers*, for the Meaſuring of *Timber*, either Round or Square; being the moſt Eaſie, Speedy, and Exact as ever was uſed.

WHEREBY,

At one ſetting to the Length, all ordinary Pieces of *Timber*, from 1 Inch to 100 Foot, is with a glance of the Eye reſolved, without Pen or Compaſſes.

Firſt Drawn by Mr. WHITE;
And ſince much Enlarged, and made Eaſie, and Vſeful, by JOHN BROWN.

LONDON, Printed for *R. Mount*, at
Poſtern-Row on *Tower-Hill*, MDCCIV.

CHAP. I.

The Uſe of the Line of Numbers *on a* Sliding-Rule, *for the Meaſuring of Superficial or Sold Meaſures.*

A *Sliding Rule*, is only two Rules, or Rule-pieces fitted together, with a Braſs-ſocket at each end, that they ſlip not out of the groove; and the *Line of Numbers* thereon, is cut a-croſs the moving Joint on each Piece, the ſame diviſions on both ſides, only the placing of the Lines differ; for on one ſide of the Rule you have one ſet at the beginning, and 10 at the end, on each piece; but on the other ſide 1 is ſet in the middle, and the reſt of the figures anſwerably both ways, on purpoſe to make it large, and to take in all Numbers; and the reading of this, is the very ſame with the other; for if you pull out the Rule, and ſet 10 at the end, right againſt 1 at the beginning, then on both pieces you have the former *Line of Numbers* compleatly;

therefore I ſhall ſay nothing as to Deſcription, or Reading of it, but come ſtreight to the Uſe.

On the edges of the Rule is uſually ſet Foot-meaſure, being the Foot or 12 Inches parted into 100 Parts; and on the flat ſides next to the Foot-meaſure, Inches in 8 Parts; and on the other flat edges on the other ſide, the Line of Board-meaſure, and ſometimes Timber-meaſure, whoſe Uſe is ſhewed in the Firſt Chapter of the Book. But Note, If the Rule be a juſt Foot when it is ſhut, as the *Glaſier's* commonly is, then the Inches are ſet alike on both ſides, and the Foot-meaſure alike on both edges; and being pulled out as far as the Braſſes will ſuffer, it wants about 1 Inch of 2 foot juſt when pull'd out, as it is made for *Carpenters* Uſe; then the Inches on one ſide, and Foot-meaſure on the ſame reciprocal edge, muſt be figured otherwiſe, as 13. 14. 15. 16. 17. *&c.* to 25 Inches, and the Foot-meaſure with 110, near the end 120, 130, 140, 150, *&c.* with 210 at the very end, ſhewing the meaſure from end to end, being drawn out to any diſtance; as is very eaſie to conceive of, and need no Example to illuſtrate it withal.

Note alſo, in uſing the *Line of Numbers*, that that ſide or part of it on which you find the firſt part or term in the queſtion, ſhall always call the firſt ſide, and then the other muſt needs be the ſecond, that the Rules and Examples may be ſhortened and made eaſie.

1. *Multiplication by the Sliding-Rule.*

Set the 1 on any ſide (which being found, I call the firſt ſide) to the Multiplicator on the other (or ſecond) ſide; then ſeek the Multiplicand on the firſt ſide where 1 was, and right againſt it on the ſecond is the Product required.

Examp. If I would multiply 25 by 28, ſet 1 on the firſt ſide to 25 on the ſecond; then juſt againſt 28 on the firſt ſide, on the ſecond is 700: for the right naming the laſt figure, and the true number of figures, you have a Rule in *Chap.* II. and *Prob* II. of the *Carpenters-Rule*, as in *pag.* 28.

2. *Diviſion*

2. *Diviſion by the Rule.*

Set the Diviſor found always on the firſt ſide, to 1 on the ſecond ſide; then right againſt the Dividend found out on the firſt ſide, on the ſecond is the Quotient required.

Examp. If I divide 156 by 12, the Quotient is 13. *Note*, To find how many figures ſhall be in the Quotient, do thus, If the two firſt figures of the Diviſor be greater than the two firſt figures of the Dividend, then the Quotient hath ſo many places or figures as there is more in the Dividend than in the Diviſor; but if it be leſs, that is to ſay, the Dividend's two firſt figures greater than the Diviſor's, then the Quotient ſhall have one place or figure more than the Dividend exceeds the Diviſor.

Examp. 2964 divided by 39, makes a Quotient 76, of two figures; but if you divide the ſame number by 18, you ſhall have the figures in the Quotient, *viz.* 164, and 12 remaining, or by the Rule, two third parts of one more, for the reaſon aboveſaid; the two firſt figures of the Dividend being greater than the Diviſor, it muſt have one place more than the difference of the number of figures in the Multiplicator and Multiplicand.

3. *The Rule of Three Direct.*

Set the firſt term of the queſtion ſought out on the firſt ſide, to the ſecond term of the queſtion on the ſecond (or other) ſide ; then right againſt the third term found out on the firſt ſide, on the ſecond ſide is the fourth proportional term required.

Examp. *If* 2 *Yards of Cloth coſt* 8 s. *what will* 11 *Yards and* $\frac{1}{2}$ *coſt ?* The anſwer is 46 *s.* for if you ſet 2 on any one ſide to 8 on the other, then look for 11 $\frac{1}{2}$ on the firſt ſide where 2 was, and right againſt it on the ſecond you ſhall find 46, the number required. *Note,* That all your Fractions on the *Line of Numbers* are Decimal Fractions, and to work them, you muſt reduce your proper Fractions to them, which, for ordinary Fractions, you may do it by Inches and Foot-meaſure. But this general Rule by the Numbers, will reduce any kind whatſoever, as thus; Suppoſe I would have the Decimal Fraction of 9 foot, 7 inch. $\frac{3}{4}$, firſt note that 9 are integers; for the reſt, ſay thus, as 48 the number of quarters in (12 inches or) 1 foot is to 1000, ſo is 31 the number of quarters in 7 inch. $\frac{3}{4}$ to 645 the decimal fraction required; for 9645 is equal to 9 foot 7 inch. $\frac{3}{4}$; and ſo for any other whatſoever.

4. *To work the Rule of Three Reverſe.*

Set the firſt term ſought out on the firſt ſide; to the ſecond, being of the ſame denomination, on the ſecond line or ſide; then ſeek the third term on the ſecond ſide, and on the firſt you ſhall have the Anſwer requir'd.

Examp. *If* 48 *Men perform a piece of work in* 24 *Hours, how many Men may there be to do the like in* 4 *Hours?* Set 24 on the firſt ſide, to 4 on the ſecond, then right againſt 48 found out on the ſecond, on the firſt is 288, the number of Men required.

5. *To work the Double Rule of Three Direct.*

To perform this, you muſt have two workings; as thus, for *Example.*

If the encreaſe of 3 buſhels of Wheat in in 1 year be 36 buſhels, what ſhall the encreaſe of 8 buſhels be for 7 years?

Firſt, ſet 3 on the firſt ſide, to 36 on the ſecond, then againſt 8 on the firſt, on the ſecond you find 96, then ſet one on the firſt ſide to 96, then againſt 7 on the firſt ſide, on the ſecond you have 612, the encreaſe in 7 years, the Anſwer required.

CHAP. II.

To meaſure Board or Glaſs by the Sliding-Rule, the Length and Breadth being given.

PROB. I.

The Breadth given, to find how much makes a Foot.

IF the breadth be given in inches, then ſet 12 on the firſt ſide, to the inches on the ſecond; then right againſt 12 on the ſecond, on the firſt is the number of inches required.

Examp. At 6 inches broad, ſet 12 to 6; then againſt 12 on the ſecond, on the firſt you have 24. But if it be given in Foot-meaſure, then inſtead of 12 uſe 1, and do in like manner as before.

Examp. At 0.50 broad, ſet 1 to 0.50, then right againſt the other 1 is 2.00, the Anſwer required.

But to find how much is in a foot long at any breadth, do thus:

Firſt, for Foot-meaſure, Juſt as the Rule ſtands even, look for the breadth on one ſide, and the quantity in a foot is on the other ſide: But for Inches, ſet 1 to 12, then right againſt the inches broad is the feet and tenths in a foot long.

Examp. At 6 inches broad is 50, or half a foot in a foot long. Again, At 30 inches broad, is 2 foot and $\frac{1}{2}$ in a foot long.

PROB. II.

The length and breadth given, to find the content.

Firſt, The breadth given in inches, and the length in feet and inches: Set 12 on the firſt ſide to the breadth on the ſecond; then right againſt the length on the firſt, on the ſecond is the content required.

Examp. At 16 inches broad, and 20 foot long: Set 12 to 16, then right againſt 20 you have 26 foot, 7 tenths; look for the 7 tenth on the Foot-meaſure, and right againſt it on the inches you have 8 inches and $\frac{1}{4}$ and $\frac{7}{8}$ quarter, the Anſwer deſired.

But if the breadth be given in Foot-meaſure, then ſet 1 to the breadth; then right againſt the length on the firſt ſide, on the ſecond you ſhall have the content required.

Examp. At 1.20 broad, 20.00 foot long, you ſhall find 24 foot. For if you ſet 1 to 1.20, then right againſt 20 foot you have on the ſecond 24, as before.

PROB. III.

The breadth given in feet and inches, and the length alſo in the ſame parts, to find the content.

Set 1 on the firſt ſide to the feet and inches brought to a decimal fraction, or as near as you can gueſs, (for 6 inches is half, 3 inches is 1 quarter, 9

9 inches is 3 quarters, 4 inches is one third, 8 inches is two thirds, and 1 inch is ſomewhat leſs than 1 tenth on on the Rule) on the other or ſecond ſide; then right againſt the length found on the firſt, on the ſecond is the content required.

Examp. At 3 foot 3 inches broad, and 9 foot 9 inches long, you ſhall have 31 foot 8 inches $\frac{1}{2}$ near; the very ſame is for Foot-meaſure (only much eaſier) becauſe the diviſions on the *Line of Numbers*, and on the Line of *Foot-meaſure* on the edge, do agree together.

This being premiſed as to the Uſing of it, you may apply all the former Precepts and Examples to this Rule, as well as the other.

CHAP. III.

To meaſure Timber by the Sliding-Rule.

PROB. III.

TO meaſure Timber by this Rule, is nothing elſe but to work the *Double Rule of Three.*

Examp. At 8 inches ſquare, and 20 foot long, I would know the content. Set 12, if the ſide of the ſquare be given in Inches, (or 1, if in Foot-meaſure) on the firſt ſide, to the 8 inches ſquare on the ſecond; then right againſt 12 on the ſecond ſide, on the firſt is 18, the fourth proportional part; then for the ſecond work, ſet 18, the fourth proportional laſt found, to 8 the inches ſquare on the ſecond; then right againſt 20 the length, is 9, the content required. Or rather thus;

Set 12 againſt 8, then right againſt 20 on the ſame ſide 12 was, is 13.5 near on; then look for 13.5 *fere* on the firſt ſide, and right againſt it on the ſecond is 9 foot, the content required.

PROB. II.

To meaſure a Piece that is not Square.

Set 12, if you uſe the inches, (or 1, if you uſe Foot-meaſure) on the firſt ſide, to the inches thick on the ſecond; then right againſt the inches broad on the firſt ſide, on the ſecond is a fourth proportional; then in the ſecond operation, ſet 2 on the firſt ſide to the fourth proportional on the ſecond, then right againſt the length on the firſt ſide, on the ſecond is the content required.

Examp. At 8 inches thick, and 16 broad, and 20 foot long, you ſhall find 18 foot *fere.*

PROB. III.

The Square given, to find how much makes a Foot.

Set the inches ſquare on the firſt ſide, to 12 on the ſecond; then right againſt 12 on the firſt, on the ſecond is a fourth proportional number: then in the ſecond work, as the inches ſquare to the fourth proportional, ſo is 12 to the number of inches required, to make a foot of Timber.

Examp. At 6 inches ſquare, ſet 6 to 12, then againſt the other 12 is 24; then ſet 6 to 24, then right againſt 12 you ſhall have 48, the length in inches required.

After the ſame manner are other Queſtions wrought, but the Compaſſes are eaſier, and more ready; therefore I ſhall ſay no more to this, but only refer you to the former Rules in the III^d. IV^th. and V^th *Chapters.* Only Note, That in thoſe *Sliding-Rules* made for *Glaſiers* Uſe, the one half of the *Line of Numbers* is on one ſide of the Rule, and the other on the other ſide; and whatſoever leg or piece of the Rule is the firſt on the one ſide, the ſame leg or piece is the firſt, when the Rule is turned, on the other ſide, which muſt be well obſerved: But Note, That for Meaſuring of Timber, thoſe that uſe it, may have one ſide fitted for that; as I ſhall more plainly and fully ſhew in the next Chapter, being the Eaſieſt, Speedieſt and Neareſt Way that ever yet was uſed by any Man, reſolving any Contents, by having the Length and the Diameter, the Circumference or Square given.

A Table *of the True Size of Glaſiers Quarries, both Long and Square; Calculated by* J. B.

Square-Quarries 77.19 gr.

Quarries.	*Rang.*	*Sides.*	*Bread.*	*Length.*	*Content in Feet.*	*Content in Inc.*
8	In.100	In.100	In. pts.	In. pts.	F. pts.	In. pts.
8	4 20-	4 30	5 36-	6 70	0. 1250	1. 50
10	3 76	3 84	4 80	6 00	0. 1000	1. 20
12	3 43	3 51	4 38	5 47	0. 0833	1. 00
15	3 07	3 13	3 92-	4 90	0. 0667	0. 80
18	2 80	2 86	3 57	4 47	0. 0555	0. 666
20	2 66	2 72	3 39	4 24	0. 0500	0. 60

Long Quarries 67. 22

Quarries.	*Rang.*	*Sides.*	*Breadth.*	*Length.*	*Content in Feet.*	*Content in Inc.*
	In. Pts.	In. Pts.	In. 100	In. Pts.	F. 100	In. Pts.
8	4 09	4. 41.	4. 90	7. 34	0. 1250	1. 50
10	3 65-	3. 95	4. 38-	6. 57	0. 1000	1. 20
12	3 34	3 61	4. 00	6. 00	0. 0833	1. 00
15	2 98.	3 23	3. 58	5. 37	0. 0667	0. 80
18	2 58	2 79.	3: 10	4. 90	0. 0555	0. 666
20	2 72-	2 94-	3. 27	4. 65	0. 0500	0. 60

Note, that a point (.) after the 100 Parts of an Inch, denotes a Quarter, and a ſtroke (-) a Half of 100 Parts of an Inch. To make this Table, work thus by the *Line of Numbers*: Divide the diſtance between the content of ſome known ſize, as ſquare-10's. or long 12's. and the content of the enquired ſize, into two equal parts; for that diſtance laid the right way (encreaſing for a bigger, or decreaſing for a leſs) from the ſides of the known ſize, ſhall give the reciprocal ſides of the enquired ſize.

Example for Square 12'*s*.

The half diſtance on the *Line of Numbers*, between 1000 the content of ſquare 10'*s*. and 0.833 the content of ſquare 12'*s*. ſhall reach from 6 the length of the ſquare 10'*s*. to 5.47 the length of ſquare 12'*s*. and from 4.80 the breadth of ſquare 10'*s*. to 4.38- the breadth of ſquare 12'*s*. and from 3.84- to 3.51, and from 3.76 to 3.43; and ſo for all the reſt.

CHAP.

CHAP. IV.

The Deſcription of the Line of Numbers on a Sliding-Rule, to meaſure Solid-meaſure only, according to Mr. White's *firſt Contrivance, but much Augmented by* J. B.

F*Irſt*, When the figures (on the Timber ſide) ſtand right towards you, fit to read, then that half or piece next to your right hand, I call the right ſide, the other is of neceſſity the left.

Secondly, The figures on the right-ſide, are, firſt at the lower end, (where the Braſs is pinn'd faſt) either 3, or 4, or 5, it matters not much which, yet to have 3 there is beſt; then upwards, 4.5.6.7.8.9.10.11. for ſo many inches; then 1.2.3.4.5.6.7.8.9.10.11.12. under the Braſs at the top, for ſo many feet, the diviſions between to 1 foot, are quarters of inches; the next above 1 foot, are only whole inches, as you may plainly ſee.

Thirdly, At 1 foot you have the word *Square*, at 1 foot, 1 inch ½ is a mark, and right againſt it is ſet T D, noting the True Diameter of a round Cylinder; at an inch farther is 12 ſet, which I call *ſmall* 12, being in ſmall figures. Again, At 1 foot 3 inches better, is another mark, and right againſt it the word *Diameter*, for the Diameter of a piece of Timber, according to the uſual *Engliſh* allowance. Then again, At 3 foot 6 inches and ½ near, is TR. for the True Circumference of a round Cylinder. Laſtly, At 4 foot is the word *Round*, noting the Circumference according to the uſual allowance, whoſe Uſe followeth. Alſo, At 13 foot 7 inches is TD. and at 3 inches and ½ is TR.

Note alſo, If you put on the Gage-points for Ale or Wine, with the mean Diameter and Length, you may Gage any Wine or Beer-veſſel, the Wine at 17 inches 15. the Ale or Beer at 18. 95. Alſo the Gage-points for a Beer-barrel at 35 inches and 9525 parts; and the Gage-point for a Barrel of Ale at 33 inches and 89645 parts.

Fourthly, The figures on the left-ſide are not much unlike the right; for 1 at the beginning is one inch, and ſo it proceeds by quarters of inches to 1 foot; then by figures at the feet, and the diviſions all whole inches to 10 foot, then every whole foot, and half, and quarter, or tenth, to 100, or 140, or 150 foot; and this I call the left-ſide, the other the right-ſide; ſo that from 1 inch at the lower-end to one foot, every inch hath a figure; from 1 foot to 10 foot, every foot hath a figure; and from 10 foot to 100, every 10th foot only is figured. I have been very plain in explaining this, becauſe I would avoid vain Repetitions in the following Uſes, wherein you ſhall have firſt the moſt ordinary and eaſie Queſtions, and then the more hard and critical, and leſs uſeful. The Uſes follow.

PROB. I.

A piece of Timber being not ſquare, to make it ſquare, or to find the Square-equal.

Set the breadth on the left-ſide, to the breadth on the right; then right againſt the inch and quarters thick found on the left-ſide, on the right is the inches ſquare required.

Examp. At 18 broad, and 6 thick, you ſhall find 10 inches $\frac{3}{8}$, the ſide of the ſquare required.

For if you ſet 6 inches againſt 6 inches on the right and left-ſide, then right againſt 18 inches, or 1 foot 6 inches on the left, on the right you have 10 inches, 1 quarter, and half-a-quarter, for the ſide of the Square-equal to 18 one way, and 6 the other way.

PROB. II.

The ſide of the ſquare given, to find how much makes a foot.

For all pieces between 3 or 4 inches and 42 inches ſquare, which are the moſt uſeful, this is the beſt way: Set the inches or feet, and inches ſquare, found out on the right-ſide, to 1 foot on the left, then right againſt 1 foot on the right, on the left is the inches or feet, and inches required to make a foot of Timber. But when the piece is ſmall, count 1 foot on the right for 1 inch, and call 12 on the right for 1 foot.

Examp. At 8 inches ſquare, ſet 8 on the right to 1 foot on the left; then right againſt one foot on the right, on the left is 2 foot 3 inches, the length required.

To find how much is in a Foot long.

Juſt as the Rule ſtands even, look for the inches the piece is ſquare on the right, and on the left is the inches, or feet and inches required.

Examp. At 17 inches ſquare, there is 2 foot of Timber in 1 foot long; which if you multiply by the length, you ſhall have the true content. A very good way for large pieces, and very exact.

PROB. III.

The ſide of the ſquare and length given, to find the content.

For all pieces between 1 inch or $\frac{1}{12}$ part of a foot, and 100 foot, this is the eaſieſt way. Set the word *ſquare,* or 1 foot, to the length on the left; then right againſt the *inches,* or *feet* and *inches* ſquare on the right, on the left you have the content.

Examp. At 9 inches ſquare, and 20 foot long; Set the (long ſtroke by the) word *ſquare* to 20 foot on the left, then right againſt 9 inches on the right ſide, on the left ſide you have 11 foot and a quarter, the content required.

But if it be a very great piece, as above 100 foot, then call 1 foot on the left ſide 10 foot, and 2 foot 20, *&c.* then 10 ſhall be an 100, and 100 a 1000, that will ſupply to 1500 foot in a piece.

But for all ſmall pieces under 3 inches ſquare, and above 1 quarter of an inch, do thus: Set 12 on the top (or the ſmall 12, when it is moſt convenient to uſe) to the length on the left ſide; then right againſt the inches (or 12's of an inch) ſquares found on the right ſide, on the left is the true content required.

Examp. At 2 inches (3 twelves or) 1 quarter ſquare, and 10 foot long) you ſhall find 4 inches and a quarter *fere*. But Note, When you uſe the ſmall 12, the Anſwer is given in decimals of a foot, therefore the top 12 is beſt.

PROB. IV.

The ſquare of a ſmall piece of Timber given, to find how much makes a foot.

For all pieces from 12 inches to 1 inch ſquare, do thus: Set the inches and (12's. or) quarters ſquare, counting 1 foot on the right ſide for 1 inch, and 2 foot for 2 inches, *&c.* found out on the right-ſide to 100 on the left; then right againſt the upper or ſmall 12 on the right, on the left is the length required to make a foot of Timber.

Examp. At 2 inch. $\frac{1}{4}$ ſquare, you muſt have 28 foot 4 inches to make a foot.

PROB. V.

Under 1 *inch ſquare, to find the length of a foot.*

Set 1 foot 9 inches, 6 inches or 3 inches, found on the right ſide, for 1 inch $\frac{3}{4}$, $\frac{1}{2}$, or $\frac{1}{4}$ of an inch, againſt 10 on the left ſide, counted for 100; then right againſt the ſmall 12 you have the feet in length required.

Examp. At 1 inch ſquare, you find 144 feet, at $\frac{3}{4}$ ſquare 256 feet, at $\frac{1}{2}$ an inch ſquare 576 feet, at $\frac{1}{4}$ or an inch ſquare you find 2034 feet in length, to make 1 foot of Timber.

Or if you ſet the former numbers 12, 9, 6, 1, againſt 1 inch on the left, then right againſt the upper 12 is a number, which multiplied by 12, is the number of feet required.

PROB. VI.

A great piece above 3 *foot $\frac{1}{2}$ ſquare, to find the length of a foot.*

I ſet

Set the feet and inches on the right, to 100 on the left; then right againſt ſmall 12 is the inches and 12's. or 12's. of a 12*th.* that goes to make a foot.

Examp. At 4 foot ſquare, you have 9. 12*ths.* or $\frac{3}{4}$ of an inch, to make a foot of Timber; at 5 foot ſquare, 5. 12*ths.* and 10. 12*ths.* of a 12*th.* to make a foot.

Thus you ſee the Rule, as now contrived, reſolves from $\frac{1}{4}$ ſquare, to 12 foot ſquare, the content or quantity of a foot of Timber in length at any ſquareneſs, without Pen or Compaſſes.

CHAP. V.

For Round Timber.

PROB. I.

The number of Inches that a piece of Timber is about, being given, to find how much makes a Foot.

Firſt, for all ordinary pieces, ſet 1 foot on the left, to the inches, or feet and inches above on the right; then right againſt TR for true meaſure,

ſure, or Round for the uſual meaſure, is the feet, or feet and inches required to make a foot of Timber at that circumference about.

Examp. At 4 inches about, 113 foot 2 inches is for true meaſure; but for the uſual meaſure, 142 foot goes to make a foot of Timber.

At 12 foot 3 inches about, 1 inch is a true foot; but for the uſual allowance, as the fourth-part of a line girt about gives, it muſt be 1 inch $\frac{1}{4}$ long, to make a foot of Timber at that circumference.

But for very large pieces, count 1 foot on the right for 12 foot, 2.24, *&c.* and ſet 1 foot on the left, as before; then in the Anſwer, 1 foot on the left is 1. 12*th.* of an inch, and 1 inch 1. 14*th.* of an inch.

Examp. At 144 foot about, 1. 144*th.* part of an inch, is a foot of Timber.

PROB. II.

For very ſmall Wood, to find a Foot in length.

But for very ſmall pieces of under 4

4 inches about, ſet 1 foot, 2 foot, *&c.* on the right (counted for 1 inch, 2 inches, 3 inches, or 4 inches) to 1 foot on the left; then right againſt TR, or Round, you have a number, which multiplied by 12, is the number of feet required.

Examp. At 1 inch round true meaſure, is 151 foot *fere*, but for the uſual allowance 196, which numbers multiplied by 12, is the number of feet required, *viz.* 1809, and 2352. But Note, you muſt read the 196, and 151 right, as thus; 1 foot on the left is 12, 2 is 24, *&c.* ſo that 12 foot is 144; and our number, by the ſame account, is 151 near.

To find how much is in a foot in length, ſet Round or TR to 1 foot on the left; then right againſt the inches, or feet and inches about, found on the right, on the left is the Anſwer required.

PROB. III.

The inches, or feet and inches about, and length given, to find the content.

Set the word *Round*, or TR, for the uſual or true meaſure, to the length on the left; then right againſt the inches about on the right, on the left is the content required.

Examp. At 2 foot 3 inches about, and 20 foot long, it is 6 foot 2 inches of the uſual allowance, or 8 foot of true meaſure.

But if it be a great Tree, then ſet TR, or Round, to 1 called 10, or to 10 called 100, then is the content augmented to 1000 foot, as you did in the Rules for Square Timber.

But if you would have it meaſure bigger ſtill, then ſet the 4 inches or a TR ſet cloſe by the Braſs on the right-ſide, to the length on the left, either as it is, or augmented, counting at laſt accordingly; the note 1 foot on the right is 12 foot, and 12 at the top is 144 foot; then right againſt the feet about on the right, on the left is the content required.

Examp. A Brewer's Tun 3 foot long or deep, and 72 foot about, ſet the TR by the Braſs to 36 inches (which is thus counted) on the left-ſide; (1 inch is 10 inches, 2 is 20, 3 is 30, $3\frac{1}{2}$ is 35, ſomewhat more is 36; ſo then 1 foot is 120 inches, or 10 foot) then right againſt 6 times 12 foot on the right (which is at 6 foot) on the left you have 12 30 foot, as near as the Rule will give it, which counting 6 foot to a barrel, is 205 barrels, the content required.

PROB. IV.

To find the content of a very ſmall piece.

Set the word Round, or TR, to the length on the left, as in the III^{d} *Problem* of this *Chapter*; then right againſt the inches about on the right, (calling 1 foot 1 inch, and 6 inches $\frac{1}{2}$ an inch) on the left is the 13'*s*. of 1 inch) or 12'*s* of a 12*th*. required.

Examp. At half an inch about, and 10 foot long, it is 2 12'*s*. and an half of 1 12*th*. of an inch, or 2 ſquare-inches and $\frac{1}{2}$ true meaſure. Again, 2 inches $\frac{3}{4}$ about, and 10 foot long, is half an inch of true meaſure, 12 inches to a foot-ſolid, or ½ a foot ſuperficial of 1 inch thick.

CHAP. VI.

To meaſure Timber, having the Diameter and the Length given.

PROB. I.

The Diameter given in Inches, to find the Length of a Foot.

SET 1 foot on the left to the inches diameter on the right; then right againſt TD for True Diameter, or the word Diameter for the uſual allowance (of a ſtring girt about and doubled four times for the ſide of the ſquare) you have the feet and inches required.

Examp. At 10 inches diameter, 1 foot 10 inches makes a foot.

But for very great pieces, ſet 1 foot as before, but look for TD beyond the upper 12, and right againſt it on the left you have the 12 of 1 inch, or the 12's of a 12, that makes a foot.

But for very ſmall ſticks, ſet 1, 2, or 3 foot on the right (for 1, 2, or 3 inches)

3 inches) to 1 foot on the left; then right againſt TD or Diameter, you have a number, which multiplied by 12, is the number of feet required to make a foot of Timber.

Examp. At 1 inch Diameter, you ſhall have 15 foot 3 inches and better, which multiplied by 12, is 123 foot 3 inches. *Note*, That 1 on the left is reckoned 10 ſoot, and 2, 20 foot, as before in the ſame Rule, for the circumference, and then note 1 inch is 10 inches.

At any diameter, to find how much is in 1 foot long, do thus; Set Diam. or TD to 1 foot, then juſt againſt the inches, or feet and inches diameter found on the right, on the left is the Anſwer.

Example. At 2 foot diameter is 3 foot 2 inches in 1 foot of length, which multiplied by the length, gives the true content of any round piece, and very exactly.

PROB. II.

The Diameter and Length given, to find the true Content.

For all ordinary pieces, ſet the word Diameter for the uſual meaſure, or TD for true meaſure, always to the length on the left; then right againſt the inches, or feet and inches diameter on the right, on the left is the content required.

Examp. At 5 inches diameter, and 30 foot long, you ſhall find 4 foot and half an inch true meaſure, for the content required.

But for very ſmall pieces, ſet TD or Diam. to the length, as before; then counting 1 foot on the right for 1 inch, and 6 inches for $\frac{1}{2}$ an inch, on the left you ſhall have the anſwer or content required. But note, as the right-ſide is diminiſh'd, ſo is the left; for 1 foot on the left is a 12*th* of an inch of Timber, whereof 12 makes a foot, or 1 long-inch, a foot long, and 1 inch ſquare, and every inch on the left is 1 ſquare-inch; thus at 2 foot long, and half an inch diameter, it is 4 □ inch. $\frac{3}{4}$ in content.

But for a great piece under 1000 foot, ſet TD or Diam. to 1, 2, or

3 foot, call'd 10, 20, or 30 foot; then right againſt the feet and inches diam. you have a content augmented accordingly, as at 30 foot long, and 7 foot diameter, you have 1140 foot for the true content, uſing TD.

Note, that in large taper Timber, whether ſquare or round, when it is meaſured by the uſual way, that is, by the middle ſquare or girt, or the two ſquares or girts put together, and the half counted for the equal ſquare, or girt; I ſay, a ſquare of half the difference of the ſquares or girts, and 1 part of the length, is to be added to the former meaſure, as is proved in the *Circles of Proportion*, pag. 50.

As thus, for Example:

Suppoſe a Taper piece be at one end 16 inches ſquare, at the other 30 inches ſquare, and 30 foot long, the ſquare in the middle is like to be 23 inches, the content then is 110 foot; now half the difference of the two ends ſquare is 7 inches, and one third-part of the length is 10 foot; a piece

7 inches ſquare, and 10 foot long, is 3 foot 5 inches, which added, is 113 foot 5 inches, the true content of that taper piece aboveſaid.

The general way of Gauging by this Rule, is thus:

Set the W. or the A. for Wine or Ale-meaſure, always to the length of the Veſſel found out on the left; then right againſt the mean Diameter found out on the right ſide, on the left is the Anſwer required.

Examp. At 30 inches diameter, and 36 long, you ſhall find about 90 gallons and a half Ale-meaſure.

The Gage-point for a Beer-barrel is near 3 foot, and the Ale-barrel near 34 inches, which uſe thus:

Set 3 to the depth of the Tun, then right againſt the mean Diameter is the Content in Barrels.

Examp. Set 3 to 36 inches, then right againſt 5 foot diameter is 10 barrels of Beer-meaſure; A very good and ſpeedy Way.

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FINIS.